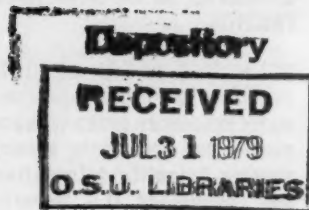


Main



SELECTED **WATER RESOURCES ABSTRACTS**



VOLUME 12, NUMBER 12
JUNE 15, 1979

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SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Research and Technology,
U.S. Department of the Interior



VOLUME 12, NUMBER 12
JUNE 15, 1979

W79-05501--W79-06000

The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

ment. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

SELECTED WATER RESOURCES

ABSTRACTS

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.



VOLUME 17, NUMBER 12
JUNE 15, 1979

W19-02321-W19-06000

Abstracts of the U.S. Department of the Interior are published in the following series: *Selected Water Resources Abstracts*, *Selected Biological Resources Abstracts*, *Selected Cultural Resources Abstracts*, *Selected Geographical Resources Abstracts*, *Selected Historical Resources Abstracts*, *Selected Mineral Resources Abstracts*, *Selected Public Lands Resources Abstracts*, *Selected Scientific Resources Abstracts*, *Selected Technical Resources Abstracts*, *Selected Wildlife Resources Abstracts*, and *Selected Miscellaneous Resources Abstracts*.

ment. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1980.

The Secretary of the U.S. Department of the Interior has determined that the publication of this periodical is necessary in the execution of the public business required by law of the Department.

SELECTED WATER RESOURCES ABSTRACTS

FOREWORD

Selecting Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstract-

ing, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on the inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the Bio-Science Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center
Office of Water Research and Technology
U.S. Department of the Interior
Washington, DC 20240

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

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05 WATER QUALITY MANAGEMENT AND PROTECTION

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06 WATER RESOURCES PLANNING

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07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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09 MANPOWER, GRANTS, AND FACILITIES

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

THE STUDY OF IONIC SOLVATION,

Pennsylvania Univ., Philadelphia.

J. O'M. Bockris, P. P. S. Saluja, and G. Madan.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-200 591. Price codes: A08 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 569, June 1970. 161 p, 56 fig, 43 tab, 24 ref. 14-01-0001-1467.

Descriptors: *Water structure, *Water properties, *Electrolytes, *Solvation, Mechanical properties, Compressibility, Water analysis, Ultrasonics, Hydration, Anions, Cations, Physical properties, Mathematical models, Aqueous solutions, Water chemistry, Desalination.

The ionic hydration aspects of the structure of aqueous electrolyte solutions were studied with regard to the method of determining the individual hydration number of cation and anion in the electrolyte solution. Two experimental methods were used in this approach to gather enough data on these hydration numbers, so that a theory on them could be formulated and the physical meaning of the concept could be clarified. The compressibility method is based on measuring the velocity of propagation of ultrasonic waves through the solution. The measurements give the compressibilities of the solution which are used to calculate the sum of the solvation numbers of the ions in the solution. The ionic vibration potential method is based on the electrical effects associated with the propagation of ultrasonic waves through solution. When a solution is subjected to ultrasonic vibration it develops a potential difference proportional to the difference of the effective masses of the cation and the anion. The potential difference is used to calculate the difference of mass of the water attached to the ion and, therefore, the solvation number of cation and anion in the electrolytic solution. A model developed for electrostriction gives good agreement between the calculated and experimental electrostriction due to the individual ions. (Davison-IPA) W79-05658

NEW YORK BIGHT WATER STRATIFICATION-OCTOBER 1974,

Lamont-Doherty Geological Observatory, Palisades, NY.

A. L. Gordon, A. F. Amos, and R. D. Gerard.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.). American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 45-57, 1976. 10 fig, 24 ref. Allen Press Inc., Lawrence, Kansas. Also as: Lamont-Doherty Geological Observatory Contribution 2402. ERDA-AT(11-1)2185.

Descriptors: *Baseline studies, *Stratification, *Water properties, Thermocline, *Outer Continental Shelf, *New York Bight, Thermohaline stratification, Pycnocline.

Thermohaline stratification of New York Bight continental shelf water during October 1974 is basically of the summer regime. Salinity increases markedly with increased distance from the coast, yet a basic vertical structure is maintained: an upper isohaline layer; a salinity maximum at the top of the thermocline; a salinity minimum at the base of the thermocline; a deep isohaline layer associated with the cold near-bottom winter residual stratum; and (over the outer shelf) a bottom intrusion of relatively saline and warm slope water. Inversions in temperature are common within the thermocline. The pycnocline is continuous over the shelf and slope, though some weakening and deepening occurs over the shelf break. Over the shelf it is mainly supported by the thermocline and over the slope by the halocline. The pycnocline may not be an effective barrier to isopycnal interchange of surface and deep layers in view of the

relative slope of isopycnals to pycnocline. In October 1974 oxygen distribution of the continental shelf was primarily two-layered, with a sharp division at the pycnocline. The lower cold layer has an oxygen concentration of near 60% of full saturation, with values near 3.6 ml/liter. This is low; if the deeper layer is principally a residue of the winter homogeneous condition with initial saturated oxygen values, it would represent oxygen consumption at a rate of 2.6 ml/liter during the six summer months after accounting for the low oxygen influx of slope water. (Sinha-OEIS) W79-05682

DISTRIBUTION OF HYDROGRAPHIC PROPERTIES IN THE NEW YORK BIGHT APEX,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.

M. J. Bowman, and L. D. Wunderlich.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.). American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 58-68, 1976. 8 fig, 28 ref. Allen Press Inc., Lawrence, Kansas. Also as: State Univ. New York Marine Sciences Research Center Contribution 145.

Descriptors: *Baseline studies, *Hydrography, *Oceanography, *Water properties, Water pollution, Water quality, *Outer Continental Shelf, *New York Bight.

Seasonal hydrographic cycles are interpreted through a series of isometric block diagrams and planimetric projections illustrating the distributions of temperature, salinity, and density in the bight apex. Seasonal cycles are typical of those found in coastal seas near river mouths in drowned river valleys in temperate latitudes. The prevailing southwest coastal drift, the right-angle bend of the coastline, seasonal and short term wind patterns, and the presence of the Hudson Shelf Valley, all influence the nearshore circulation. (Sinha-OEIS) W79-05683

2. WATER CYCLE

2A. General

HYDROLOGY AND WATER CONTROL ON LARGE PLAINS,

National Water Authority, Budapest (Hungary). Dept. of Water Resources Development.

G. Kovacs.

Hydrological Sciences Bulletin, Vol. 23, No. 3, p 305-332, September 1978. 27 fig, 4 ref.

Descriptors: *Water control, *Hydrology, *Depression storage, Infiltration, Runoff, Drainage, Land reclamation, Canals, Lakes, Geology, Groundwater, Evapotranspiration, Soil water, Soil moisture, Water balance, *Plains, *Hungary.

The hydrological processes developing in extensive plains differ considerably from those characterizing hilly and mountainous areas (sloping terrain in general). The surface of a plain has no slope at all, or the slopes are negligible and interrupted by local depressions. The runoff is extremely small compared to evaporation and infiltration, and the latter two balance the precipitation almost completely. The local depressions storing the precipitation temporarily as shallow pools form the basis of the hydrological network, instead of the sloping beds of rivers and streams. The excess water surpassing the storage capacity of the pools moves on the surface as sheet flow or erodes shallow channels. Since the difference in elevation between the various parts of the plain is relatively small, the potential maintaining the natural water movement on and below the surface may be modified considerably by human activities. The design of water control and land reclamation projects requires, therefore, very farseeing research. The local conditions give only limited information for this because the natural system may be basically different from that created artificially. Observa-

tional data from areas where water control projects have already been executed have a more important role when planning reclamation projects for large plains than in the case of the hydrological investigation of basins with some degree of slope. (Sims-ISWS) W79-05526

RIVER RUNOFF REGULATION AND WATER-MANAGEMENT CALCULATIONS, (METODIKA REGULIROVANIYA STOKA I VODOKHOZYAISTVENNYKH RASCHETOV),

For primary bibliographic entry see Field 4A.

W79-05544

SOME RESULTS FROM URBAN RUNOFF STUDIES IN BERGSJON GOTEBORG,

Chalmers Univ. of Technology, Goteborg

(Sweden). Dept. of Hydraulics.

V. Arnell, and S. Lyngfelt.

In: Geohydrological Research at the Chalmers University of Technology, Goteborg: Papers Presented at the Nordic Hydrological Conference in Reykjavik, August 29 to September 1, 1976, p 14-23, May 1977. 8 fig, 4 ref.

Descriptors: *Urban runoff, *Rainfall, *Model studies, *Mathematical models, Runoff, Drainage, Storage, Watersheds(Basins), Rainfall-runoff relationships, Sewers, Storms, Storm runoff, Infiltration, Hydrographs, Cities, Urban hydrology, Foreign research, *Sweden.

Urban runoff measurements carried out by the Department of Hydraulics, Chalmers University of Technology, were used to study such runoff characteristics as the relationship between rainfall and runoff volumes for separate storms. Runoff hydrographs simulated by a mathematical runoff model were compared with measured hydrographs. Experience in application resulted in improvement of the model; thus the accuracy of calculation was improved at the same time as the cost of simulations was cut down. (See also W79-05546) (Sims-ISWS) W79-05548

AN OUTLINE OF SOIL, WATER AND AGRICULTURE IN ARAB COUNTRIES,

Alexandria Univ. (Egypt). Dept. of Soil Science. A. Balba.

Journal of the Middle East, Vol. 2, p 59-82, 1975. 41 ref.

Descriptors: *Optimum development plans, *Surveys, *Data, *Institutional constraints, *Resources, *Data collection, Water resource planning, Geomorphology, Calcareous soils, Sands, Saline soils, Groundwater resources, Precipitation(Atmospheric), Surface waters, Economic feasibility.

The Arab world contains a variety of physiographic and climatic features that will require comprehensive and integrated surveys of the area's natural resources before development programs can succeed. This paper points out both the need for such inventories and the agricultural potential that could be realized when such resource information becomes available. The author discussed the properties, formation, and distribution of the predominantly sandy, calcareous, and salt-affected soils as they are now known, as well as surface and groundwater resources of the area. Suitable crops for the prevailing conditions include cereals, cotton, fruit, and livestock feeds. Rainfall, streamflow, and underground water, and the agricultural development that can be supported by these resources are detailed together with an analysis of the need for trained manpower, capital investment, and integrated development projects. (Tickes-Arizona) W79-05553

TWENTIETH-CENTURY SEMI-ARID CLIMATES AND CLIMATIC FLUCTUATIONS IN TEXAS AND NORTHEASTERN MEXICO,

Texas Instruments Inc., Dallas. Ecological Serv-

Field 2—WATER CYCLE

Group 2A—General

ices.

J. Norwine.

Journal of Arid Environment, Vol. 1, No. 4, p 313-325. December, 1978, 9 fig, 6 ref.

Descriptors: *Agroclimatology, *Weather data, *Climatic data, *Variability, *Hydrologic data, *Cycles, Hydrologic cycle, Data collections, Meteorology, Depth-area-duration analysis, Droughts, Forecasting, Mexico, Texas, Semiarid climates.

South, central, and western Texas and northeastern Mexico are important food production areas suffering from dynamic unreliable climatic patterns. The climatology of this region is analyzed here for the implications of these climatic fluctuations for agriculture in the context of answers to such questions as: (1) has this semiarid region experienced any 20th century detectable cycles or climatic periodicities, (2) have significant long lasting trends occurred, and if so, of what nature and when, (3) could practical use of the answers to such questions be made. Data collected from 50 meteorological Texas stations and 40 northeastern Mexican stations were subsequently narrowed to that from 10 widely spaced stations in four subregions: the coastal plain of northeastern Mexico, south Texas, central Texas, and the north Texas High Plains, combined and averaged to provide mean, maximum, and minimum values. Although no regular periodicity of rainfall was found in the region, it was noted that droughts and wet spells, once begun, persisted for 10-30 year periods. The author believes that the best use to be made of such trends is to develop a set of recommended strategies to be adopted to best cope with eventualities as they began to take recognizable form. A drought alert, for instance, could be issued at the appropriate time, and strategies to cope could be enunciated, as is already being done in Australia. (Tickes-Arizona)

W79-05563

DRY CLIMATES—PAST AND PRESENT,

R. G. Barry.

Progress in Physical Geography, Vol. 2, No. 1, p 116-127, 1978, 1 fig, 1 tab, 74 ref.

Descriptors: *Climatology, *Weather patterns, *Paleoclimatology, *Circulation air, Atmospheric pressure, Climatic zones, Cloud physics, Fronts (Atmospheric), Hydrologic cycle, Meteorology, Topography.

A review of recent climatological research into dry climates is presented with emphasis upon possible mechanisms of change through time. For the purpose of this analysis four fundamental causes of aridity are assumed: (1) large-scale atmospheric subsidence associated with the descending arms of the tropical hadley cells, (2) local subsidence induced by topographic or other effects on the atmospheric circulation, (3) an absence of moist air-streams due to remoteness from moisture sources or a predominance of airflows from dry areas, and (4) an absence of weather systems that can induce precipitation of moisture in the air. Although it is now difficult to draw global generalizations about past climates in arid regions from available data, a clearer picture has recently begun to emerge. All such paleoclimatic considerations must take into account the fundamental principle that the maintenance of a global atmospheric circulation requires that on average there be subsiding air over the subtropics with high pressure cells. A brief review of recent paleoclimatic research of the arid regions based upon the principle of atmospheric circulation is presented while pointing out the essential requirement that critical events be firmly dated. It is concluded that a better understanding is required of the climatic factors which control the biological, hydrological and geological indicators of paleoclimatic conditions. (Tickes-Arizona)

W79-05570

HYDROLOGIC DATA FOR THE ANTLERS AQUIFER, SOUTHEASTERN OKLAHOMA, Geological Survey, Oklahoma City, OK. Water Resources Div.

R. E. Davis, and D. L. Hart, Jr.

Geological Survey open-file report 78-1038, November 1978, 24 p, 5 tab, 3 ref.

Descriptors: *Groundwater resources, *Aquifer characteristics, *Well data, *Water quality, *Low flow, Streamflow, Water analysis, Chemical analysis, Water wells, Water yield, Water levels, Water utilization, *Antlers aquifer, *Southeastern Oklahoma.

This report contains records of water wells, test holes, springs, and low-flow stream discharges for the Antlers aquifer, southeastern Oklahoma. Results of analyses for common constituents, selected trace elements, and radiochemical constituents in water from selected wells are included also. (Woodard-USGS)

W79-05590

SURFACE AND GROUNDWATER STUDY OF THE WHITE RIVER, OSAGES COUNTY, NEBRASKA,

Chadron State Coll., NE.

L. Agenbroad.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 267, Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center, University of Nebraska, Lincoln, Project Completion Rept. Sept. 1978, 25 p. OWRT A-060-NEB(1), 14-34-0001-8029.

Descriptors: Data collection, *Stream gaging, Groundwater, Surface water, White River, Precipitation, Network.

The objective was to survey, monitor and analyze the local hydrologic conditions of the White River watershed in Nebraska. Initial work began in July 1972 and has continued sporadically since that date. The data collection network includes both a stream gage and well monitoring system for a 675-square mile portion of the watershed. Surface water quality data are being collected as well as precipitation data from an expanded rain gage network. Preliminary analysis of the precipitation, groundwater and surface water data has begun. Presently, 7 1/2-minute topographic maps are not available, thus a flow net analysis of the study area has not yet begun. Surface water acreage has been determined for consumptive use calculations. Preparation for nitrate and phosphate analysis has been made, and stream terrace mapping has begun.

W79-05801

WALKER BRANCH WATERSHED: SITE DESCRIPTION AND RESEARCH SCOPE,

Oak Ridge National Lab., TN. Environmental Sciences Div.

W. F. Harris.

Available from the National Technical Information Service, Springfield, VA 22161 as CONF-770209-8, Price codes: A02 in paper copy, A01 in microfiche. Publication No 1070. (1977). 15 p, 2 fig, 32 ref. ERDA-NSF-AG-199, DEB76-00761.

Descriptors: *Watersheds (Basins), *Nutrients, *Instrumentation, *Appalachian mountain region, *Tennessee, *Biological communities, *Hydrologic budgets, Hydrology, Mountain forests, Ecosystems, Budgeting, Forest watersheds, Chemicals, Streams, Model studies.

Walker Branch Watershed is located in the Ridge and Valley section of Tennessee. The watershed (97 hectare consisting of 2 subwatersheds) is underlain by Knox Dolomite; soils formed over the dolomitic substrate are deep, well-drained Typic Paleudults. The watershed is forested. The overstory is predominantly oak-hickory, with lesser amounts of pine and mesic hardwoods. The project was initiated in 1967 with the following objectives: (1) to relate the productivity and water quality of the stream to the productivity and nutrient balance of the adjacent terrestrial ecosystem; (2) to relate the net loss of nutrient elements to the rate of nutrient cycling; (3) to define the relationship between the hydrologic cycle and nutrient flux; (4) to provide benchmark information on natural terrestrial-aquatic ecosystems for comparison with man-

modified situations; and (5) to enable the measurement of environmental degradation caused by man's cultural practices. Research has been completed or is on-going in several distinct, but related, areas: ecosystem analysis of essential element dynamics, atmospheric and hydrologic input-output processes, and trace element biogeochemistry. Objectives have been approached by analysis of the role of important biological and physical processes, attempting then to relate this understanding to the observed behavior of the landscape unit. In this research, mathematical modeling was used to organize and analyze data and to formulate a direction for field research. (Adams-ISWS)

W79-05837

APPLICATION OF RIDGE REGRESSION ANALYSIS TO WATER RESOURCES STUDIES,

Agricultural Research and Education Center, Belle Glade.

S. F. Shih, and W. F. P. Shih.

Journal of Hydrology, Vol. 40, No. 1/2, p 165-174, January 1979, 2 fig, 2 tab, 16 ref.

Descriptors: *Water resources, *Florida, *Water balance, *Lakes, *Regression analysis, Rainfall, Inflow, Discharge (Water), Evaporation, Water levels, Storage, Water storage, Water supply, Analytical techniques, *Lake Okechobee (FL), Analysis application.

Ridge regression was introduced to solve the multicollinearity in multiple regression. The water storage computation for Lake Okechobee, Florida, was used as an example to demonstrate the techniques of applications. The performance of optimum ridge regression analysis (OPT) was compared with the ordinary least-squares method (OLS). The results of ridge regression analysis showed that the computed lake storage deviation from record was affected not only by the inflow, as inferred from the OLS method, but also by both rainfall and inflow. The mean square error of estimation obtained by the OPT method decreased about 42% from that obtained by the OLS method. (Sims-ISWS)

W79-05833

REGIONAL MEAN BOWEN RATIOS DEDUCED FROM DIURNAL CHANGES OF TEMPERATURE AND HUMIDITY,

Edinburgh Univ. (Scotland). Dept. of Meteorology.

J. C. Curran.

Journal of Hydrology, Vol. 40, No. 1/2, p 113-121, January 1979, 5 fig, 15 ref.

Descriptors: *Temperature, *Humidity, *Europe, Vertical migration, Mixing, Boundary layers, Entrainment, Profiles, Climatology, Maps, Annual, *Bowen ratio, Vertical mixing, Planetary boundary layer, Entrainment theory, Vertical profiles, Potential temperature, Climatological parameters, Annual sunshine.

The ratio of diurnal changes of temperature and humidity appeared unrelated to local Bowen ratio unless vertical mixing within the planetary boundary layer was taken into account. This was accomplished by extending entrainment theory and relating the mean annual vertical profiles of potential temperature and humidity to the climatological parameter of annual sunshine. It was then possible to calculate regional mean Bowen ratios from mean diurnal changes of temperature and humidity. As an example of the method, a map of European Bowen ratios was constructed. (Robert-ISWS)

W79-05883

BENTHIC INVERTEBRATES IN A NORTH-FLOWING STREAM AND A SOUTH-FLOWING STREAM, BROOKS RANGE, ALASKA,

Geological Survey, Menlo Park, CA. Water Resources Div.; and Geological Survey, Menlo Park, CA. Conservation Div.

K. V. Slack, J. W. Nauman, and L. J. Tilley.

Water Resources Bulletin, Vol 15, No 1, p 108-135,

Precipitation—Group 2B

February 1979. 5 fig, 7 tab, 86 ref.

Descriptors: *Benthic fauna, *Alaska, *Natural streams, *Baseline studies, *Invertebrates, *Distribution patterns, Sampling, Diversification, Lotic environment, *Chironomidae, *Pre-trans-Alaska pipeline, Fifth-order streams, Brooks Range area.

Benthic invertebrate faunas were compared to two fifth-order streams in Alaska, the Atigun River flowing northward and the Dietrich River flowing southward. The trans-Alaska pipeline corridor traverses both drainage basins, crossing the Continental Divide at Atigun Pass. This study, which preceded pipeline and road construction, was conducted when the area was essentially free from cultural influences. The objectives were to compare species composition and diversity in arctic streams of similar size but different aspect and to examine the relationship between stream order and faunal distribution. The study was conducted during a four-day period in August 1971. Sixty-eight taxa were collected, forty-nine from each stream. Aquatic insects comprised 88% of the taxa and 97% of the individuals from the Dietrich River and 73% of the taxa and 97% of the individuals from the Atigun River. Diptera, especially Chironomidae, were most abundant. Plecoptera, Ephemeroptera, Oligochaeta, Acarina, and Colembola were significant. In both streams the headwaters were dominated by the subfamily Diaminae which was replaced by Orthocladinae downstream. Diversity seemed to increase with stream order. Cluster analysis showed a high degree of resemblance between the benthic faunas of the rivers. Faunal resemblance decreased with increasing distance between stations, both within and between the streams. (Woodard-USGS)

W79-05965

2B. Precipitation

ANALYSIS OF COOL SEASON LAKE-RELATED MESOSCALE PHENOMENA USING NUMERICAL VARIATIONAL ANALYSIS

National Weather Service, Silver Spring, MD. Techniques Development Lab.

T. H. Grayson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 619. Price codes: A09 in paper copy, A01 in microfiche. Final Report, December 1976. 174 p, 63 fig, 5 tab, 61 ref, 2 append.

Descriptors: *Weather, *Arctic, *Lakes, *Great Lakes, *Model studies, *Lake Ontario, Winds, Atmospheric pressure, Temperature, Air temperature, Convection, Winter, Atmosphere, Precipitation (Atmospheric), Mathematical models, Meteorology, Mesoscale.

An analysis model, based on Sasaki's variational technique, was utilized to describe the fields of atmospheric motion, temperature, and specific humidity over Lake Ontario at 2 times during the invasion of the lake by an Arctic air mass. The 2 times chosen were: (1) when the leading edge of the cold air mass was encroaching upon the lake, and (2) 15 hours later, when the air mass completely filled the lake basin. Special surface and upper-air data collected in conjunction with the International Field Year for the Great Lakes were interpolated to 11 sigma surfaces extending from the earth's surface to 500 mb. The weak constraint variational formulation was used with variable weights assigned to the interpolated data. The analyses showed that the cold surge was accompanied by 3 lines of organized convective activity over the lake. Surface convergences of greater than 0.0004/s were associated with the lead squall line, while convergences of 0.0002/s were associated with the other areas of convective activity. (Sims-ISWS)

W79-05523

CLIMATIC ROLES OF ICE: A CONTRIBUTION TO THE INTERNATIONAL HYDROLOGICAL PROGRAMME (IHP), Colorado Univ., Boulder.

For primary bibliographic entry see Field 2C. W79-05527

EFFECT OF CLIMATIC WARMING ON THE WEST ANTARCTIC ICE SHEET

Maine Univ. at Orono. Inst. for Quaternary Studies. For primary bibliographic entry see Field 2C. W79-05528

DRY CLIMATES—PAST AND PRESENT, For primary bibliographic entry see Field 2A. W79-05570

MAXIMUM RAINFALL INTENSITY IN DIFFERENT PERIOD INTERVALS IN IRAQ

Institute for Applied Research on National Resources, Baghdad (Iraq). M. Gangopadhyaya, and G. F. Kaka. Journal of the Geological Society of Iraq, Vol. 8, p 48-56, 1975. 2 tab, 4 fig, 3 ref.

Descriptors: *Rainfall intensity, *Probable maximum precipitation, *Weather patterns, *Iraq, *Weather data, *Depth-area-duration analysis, *Project planning, Design flood, Rainfall disposition, Run-off forecasting, Distribution patterns, Analytical techniques, Frequency, Industrial growth, Planning, Data collections, Climatic data.

Iraq's national development plan, putting emphasis upon industrial growth, will require special climatological data to adequately design drainage networks and choose suitable locations in the event of temporary flooding. Primary to this endeavor is the determination of maximum possible rainfall intensities for short intervals. Unfortunately the country has an insufficiently long series of data and too few recording stations upon which to derive these estimations. In order to overcome this difficulty all of the available data from all of the stations in Iraq was pooled and it was assumed that the whole country is meteorologically homogeneous. This assumption was justified on the consideration that the situations which produce high intensity rainfall (depressions, instability phenomenon, etc.) occur with the same degree of efficiency in all parts of Iraq. On this basis, a formula where rainfall intensity measured in millimeters per hour and time in hours during which the intensity is measured provides a fair estimate of the maximum rainfall intensity during various intervals. (Tikes-Arizona)

W79-05571

REVIEW REPORT ON UMPQUA RIVER AND TRIBUTARIES, OREGON, INTERIM REPORT, SOUTH UMPQUA RIVER, VOLUME III; APPENDIX B—HYDROLOGY, METEOROLOGY, AND RESERVOIR REGULATION; APPENDIX C—FOUNDATION AND MATERIALS DATA; APPENDIX D—RECREATION, PUBLIC USE, AND ENVIRONMENT

Army Engineers District, Portland, OR. For primary bibliographic entry see Field 8A. W79-05616

COMPUTATION OF THE AVERAGE PRECIPITATION OVER THE WESTERN PART OF PENINSULAR INDIA DURING THE SUMMER MONSOON FROM THE CONTINUITY EQUATION FOR ATMOSPHERIC WATER VAPOUR, Institute of Tropical Meteorology, Poona (India). S. N. Bavadekar, and D. A. Mooley. Tellus, Vol. 30, No. 6, p 537-541, December 1978. 1 fig, 4 tab, 3 ref.

Descriptors: *Monsoons, *Precipitation (Atmospheric), *Water vapor, *Model studies, Mathematical models, Equations, Evapotranspiration, Winds, Humidity, Moisture content, Rainfall, Weather, Meteorology, *India, Convergence, Water vapor flux.

Water vapor fluxes computed across different walls of the triangular volume of peninsular India, bounded by Trivandrum, Bombay, and Nagpur,

were used to compute the net flux convergence on a monthly mean basis for the months June through September for the years 1967-72. The precipitation rates over the region were computed by using the flux convergence values and the equation of continuity for water vapor and were compared with the actual rainfall. The agreement between the computed precipitation and actual rainfall was found to be fairly close. (Sims-ISWS)

W79-05619

ACID PRECIPITATION IN THE NEW YORK METROPOLITAN AREA: ITS RELATIONSHIP TO METEOROLOGICAL FACTORS

Interstate Sanitation Commission, New York. For primary bibliographic entry see Field 2K. W79-05626

A STATISTICAL STUDY OF THE ANNUAL RAINFALL IN THE SUTLEJ CATCHMENT AND ANNUAL RUN-OFF AT BHAKRA DAM SITE

Meteorological Office, New Delhi (India). R. S. Pareek, S. K. Dube, and S. D. S. Abbi. Indian Journal of Meteorology, Hydrology, and Geophysics, Vol. 27, No. 3, p 309-315, July 1976. 4 fig, 4 tab, 10 ref.

Descriptors: *Rainfall, *Runoff, *Statistics, Annual, Data processing, Weather data, Precipitation (Atmospheric), Analytical techniques, Statistical methods, Average runoff, Variability, Time series analysis, Mathematics, Weather, Meteorology, *India.

An analysis of the annual rainfall of three selected stations with long term data in Sutlej catchment and the annual runoff at Bhakra dam site was made for their averages and standard deviations. Each series was examined for general trend by (1) the low pass filter, (2) Mann-Kendall test and (3) comparison of short period averages with long period average. Further, the periodicities in the data series were examined by power spectral analysis. (Sims-ISWS)

W79-05628

A STUDY OF LARGE FLOODS IN THE THAMBRAPARANI RIVER IN TAMIL NADU

Observatory, New Delhi (India). For primary bibliographic entry see Field 2E. W79-05629

ASSESSMENT OF WEATHER MODIFICATION IN ALLEVIATING AGRICULTURAL WATER SHORTAGES DURING DROUGHTS

Illinois State Water Survey, Urbana. F. A. Huff, and J. L. Vogel.

Final Report, December 1977. 142 p, 34 fig, 44 tab, 39 ref, 2 append. NSF ENV74-24367.

Descriptors: *Weather modification, *Cloud seeding, *Droughts, *Agriculture, *Illinois, Rainfall, Precipitation (Atmospheric), Clouds, Statistics, Depth-area curves, Spatial distribution, Temporal distribution, Distribution patterns, Cloud physics, Climatology, Meteorology.

The major objective was to assess the potential utility of weather modification in stimulating crop production during droughts of various severity in the Midwest. A secondary objective was to develop techniques for applying precipitation climatology in assessing the feasibility and potential benefits of cloud seeding during growing season droughts. This research was limited to Illinois which is typical of much of the Midwest in climate, soils, and crop production. Analytical results were presented which describe the natural rainfall distribution in droughts of various severity in Illinois. Relationships were provided among storm mean rainfall, areal extent of storm rainfall, rainfall intensity, and drought size (severity) on the basis of frequency of occurrence. Synoptic weather conditions under which drought rainfall occurs most frequently, its diurnal distribution, and other factors pertinent to planned weather modification were discussed. This information can be used to evaluate weather modi-

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fication potential and to plan cloud seeding operations, provided that the weather modifier can specify enhancement capabilities under various combinations of natural weather conditions, and that the agriculturist can define the economic benefits that would be derived from the specified enhancement. (Sims-ISWS)
W79-05836

MONITORING AREAWIDE RURAL WATER QUALITY.
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5A.
W79-05842

AN AUTOMATIC SEQUENTIAL RAIN SAMPLER.
Laboratoire de Chimie Inorganique et Nucleaire, Chemin du Cyclotron, Louvain (Belgium).
For primary bibliographic entry see Field 7B.
W79-05847

THE OCCURRENCE OF ORGANOCHLORINE RESIDUES IN RAINWATER.
Freshwater Fisheries Lab., Pitlochry (Scotland).
For primary bibliographic entry see Field 5A.
W79-05848

WET AND DRY DEPOSITION OF NUTRIENTS IN CENTRAL ALBERTA.
Alberta Univ., Edmonton.
For primary bibliographic entry see Field 5B.
W79-05849

AN ANALYTICAL MODEL OF RAINFALL INTERCEPTION BY FORESTS.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W79-05854

PERSISTENCE AND OROGRAPHIC MODULATION OF MESOSCALE PRECIPITATION AREAS IN A POTENTIALLY UNSTABLE WARM SECTOR.
Royal Signals and Radar Establishment, Malvern (England). Radar Research Lab.
F. F. Hill, and K. A. Browning.
Quarterly Journal of the Royal Meteorological Society, Vol. 105, No. 443, p 57-70, January 1979. 10 fig, 17 ref.

Descriptors: *Precipitation(Atmospheric), *Rainfall, *Orography, *Persistence, Weather, Distribution patterns, Rain gages, Radar, Remote sensing, Movement, Data processing, Analytical techniques, Meteorology, *England.

Data from radars and raingages in England, Wales, and southern Ireland were used to study the motion and changes in intensity of mesoscale precipitation areas (MPAs) some tens of kilometres across as they traversed two regions of high land and an intervening stretch of sea. The MPAs studied were associated with an area of middle-level potential instability within a windy and moist wintertime warm sector, a situation known to produce major orographic effects. Despite the very large modulation of the rainfall intensity by orography, it was found that most of the MPAs could be tracked for 6 h over a distance of 600 km, all the way from the west coast of Ireland to southern England. The implications of this were discussed with regard to the use of radar and satellite data in short-period forecasting. (Sims-ISWS)
W79-05855

DEW AND THERMAL LAG: A MODEL FOR COCOA PODS.
Nottingham Univ. (England). School of Agriculture.
J. L. Monteith, and D. R. Butler.
Quarterly Journal of the Royal Meteorological Society, Vol. 105, No. 443, p 207-215, January 1979. 7 fig, 10 ref.

Descriptors: *Dew, *Dew point, *Condensation, *Model studies, Mathematical models, Humidity, Temperature, Air temperature, Heat balance, Heat transfer, Thermal capacity, Wetting, Winds, Meteorology, *Cocoa pods, Black Pod disease.

Dew forms on cocoa pods after sunrise when the dew-point temperature of air in the canopy rises faster than the surface temperature of the pods. Exchanges of heat and water vapor were estimated by treating a pod as an isothermal body with homogeneous thermal properties. Two treatments of this simple model were discussed. First, the heat balance equation was simplified to a form which allowed the environmental limits for condensation to be derived explicitly. Second, the equation was solved numerically to find the duration and mean depth of wetness as a function of environmental variables. Consistent with observation, the thermal lag of the pod was about 1 to 3K; condensation to a depth of 10 to 20 micrometers occurs when air at sunrise is almost saturated and windspeed is light. Condensation on cocoa pods is likely to be significant in the spread of Black Pod, a serious fungal disease. (Sims-ISWS)
W79-05856

PROBABLE MAXIMUM PRECIPITATION ESTIMATES, UNITED STATES EAST OF THE 105TH MERIDIAN.
National Weather Service, Silver Spring, MD. Office of Hydrology.
L. C. Schreiner, and J. T. Riedel.
Available from Supt. of Documents, GPO, Washington, DC 20402. Price, \$3.50
Hydrometeorological Report No. 51, Washington, D.C., June 1978. 93 p, 47 fig, 5 tab, 38 ref, 1 append.

Descriptors: *Probable maximum precipitation, *Precipitation(Atmospheric), *Probability, *United States, Maps, Estimating, Storms, Rainfall intensity, Drainage area, Duration curves, Time, Meteorology, Data collection, *Generalized estimates, *Rainfall rates, All-season estimates, Individual drainage estimates, Hypothetical areal rainfall.

Generalized estimates of probable maximum precipitation, the greatest rainfall rates for specified durations theoretically possible, were presented for the United States east of the 105th meridian. They were all-season estimates, the greatest for any time of the year, for drainages from 10 to 20,000 square miles and for durations of 6 to 72 hours. Details of the procedures and methods used for developing the estimates were described. Critical spring soil conditions with snow on the ground, in combination with spring season probable maximum precipitation values, could yield greater flood peaks. The probable maximum precipitation values of this study were termed generalized estimates, which means that isolines of probable maximum precipitation were given on a map, allowing determination of average probable maximum precipitation for any drainage. (Roberts-ISWS)
W79-05863

2C. Snow, Ice, and Frost

ESTIMATION OF SNOW TEMPERATURE AND MEAN CRYSTAL RADIUS FROM REMOTE MULTISPECTRAL PASSIVE MICROWAVE MEASUREMENTS.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. T. C. Chang.
Available from the National Technical Information Service, Springfield, VA 22161 as N78-26677. Price codes: A02 in paper copy, A01 in microfiche.
NASA Technical Paper 1251, June 1978. 14 p, 5 fig, 1 tab, 10 ref.

Descriptors: *Remote sensing, *Snow cover, *Microwaves, *Model studies, Mathematical models, Snow, Measurement, Satellites(Artificial), Temperature, Melting, Snowmelt, Meltwater, Ice, Water resources, Equations, Data processing, Sta-

tistical methods, Analytical techniques, Microwave emission, Radiometry, Rayleigh scattering.

Recent work by A.T.C. Chang, et al, has demonstrated that variation in crystal size and physical temperature of snowfield observations from space give large variations in the microwave brightness temperature. Since the brightness temperature is a function of wavelength, the microwave brightness temperature can be used to extract the snow temperature and mean crystal radius profiles. The Scanning Multichannel Microwave Radiometer (SMMR), to be launched on board the Nimbus-G and Seasat-A spacecraft, will make observations in wavelengths of 0.8, 1.4, 1.7, 2.8, and 4.6 cm. A statistical retrieval method was developed in this paper to determine the snowfield temperature profile and mean crystal size by using the scanning multifrequency microwave radiometer on board a spacecraft. The estimated errors for retrieval are approximately 1.5 K for temperature and 0.001 cm for crystal radius in the presence of 1 K rms noise for each SMMR channel. The computational method presented may also provide a basis for utilizing SMMR data to further develop a new retrieval technique for eventual incorporation into satellite weather and climate data collecting systems. (See also W77-10687) (Froehlich-ISWS)
W79-05518

CLIMATIC ROLES OF ICE: A CONTRIBUTION TO THE INTERNATIONAL HYDROLOGICAL PROGRAMME (IHP).
Colorado Univ., Boulder.
U. Radok.
Hydrological Sciences Bulletin, Vol. 23, No. 3, p 333-354, September 1978. 7 fig, 1 tab, 89 ref.

Descriptors: *Ice, *Climatology, *Glaciology, *Model studies, *Antarctic, Mathematical models, Glaciers, Sea ice, Snow, Snow cover, Mountains, Polar regions, Climates, Weather, Temperature, Meteorology, Reviews, Ice sheets, Ice sheet dynamics, Mountain glaciers.

Terrestrial ice is featuring prominently in current speculations about consequences and causes of marked climatic anomalies. This review was an attempt to provide the climate debate with a cryospheric sense of proportion matching present glaciological knowledge and understanding. Short climatic fluctuations on the time scale of months to decades involve primarily the seasonal and more "volatile" ice forms, snow and sea ice. Focused process experiments and effective monitoring techniques for the extents and characteristics of climate fluctuations, both in regional detail and in global completeness, are laying a firm basis for incorporating these cryospheric features into climate models and for testing model results against current reality. It was concluded that snow and sea ice have now emerged from their basic problematics, covered by a few references to the published literature. The more traditional cryospheric emphasis in climatology has been on the behavior of glaciers and ice sheets. Progress towards computer modeling of glaciers was appraised. Although at the opposite end of the time scales of climate, polar ice sheets are as important for understanding climate as are snow and sea ice. Cores from these ice sheets provide records of their history which has created their temperature and their distribution of stable and radioactive isotopes, trace chemicals, and dust. But the dynamics of these ice masses is also involved and must be modelled for an unambiguous interpretation of the core records in terms of past climate. (Sims-ISWS)
W79-05527

EFFECT OF CLIMATIC WARMING ON THE WEST ANTARCTIC ICE SHEET.
Maine Univ. at Orono. Inst. for Quaternary Studies.
R. H. Thomas, T. J. O. Sanderson, and K. E. Rose.
Nature, Vol. 277, No. 5695, p 355-358, February 1, 1979. 3 fig, 18 ref.

Descriptors: *Glaciers, *Antarctic, *Climatology, Melting, Warming, Climates, Ice, Cold regions,

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Sea level, Temperature, Air temperature, Water temperature, Meteorology, Ice sheets, Ice shelves.

Climatic warming could cause increased melting from Antarctic ice shelves. Continued weakening of the ice shelves in this way would result in the ultimate collapse of most of the West Antarctic ice sheet. For complete removal of the ice shelves, collapse of the ice sheet and a 5 m rise in world sea level could occur in less than 100 yr. More realistically, ice-shelf deterioration is likely to be a rather slow process. Even for a major and sustained warming trend, ice-sheet collapse would take several hundred years, with most of the associated rise in sea level occurring during the final century. However, little is known about the glaciers that drain the northern part of the ice sheet. These glaciers have little or no protective fringe of ice shelf and, unless they flow over sufficiently high bedrock sills, they may show a more rapid response to increased temperatures. (Sims-ISWS) W79-05528

PROBLEMS OF THE PERIGLACIAL ZONE (ZAGADNIENIA STREFY PERYGLACJALNEJ).

A. Jahn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 901. Price codes: A13 in paper copy, A01 in microfiche. TT 72-54011, U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia, 1975. 134 p, 129 fig, 116 photo, 583 ref.

Descriptors: *Geologic history, *Glaciation, *Europe, Climates, Underground, Valleys, Foreign countries, Foreign research, Pleistocene epoch, Geology, Permafrost, Glaciology, Ice, Karst, Frost, Lakes, Thawing, Erosion, Slopes, Loess, Oscillation, Cold regions, *Periglacial zone, Ice wedges.

Sixty years have passed since a new field of study concerned with the geographic periglacial zone was inaugurated. After the last war, as more and more factual material has been collected, interest in this field of study has grown. Periglacial research centers have been established in various countries, including Poland, the Soviet Union, France, Federal Republic of Germany, and the United States. What is behind this world-wide appreciation of periglacial problems. The answer seems to be that these problems run over a broad front and across the boundaries of three sciences, geology, geography, and pedology. In this setting they open great opportunities for researchers in various fields of study. They relate to contemporary phenomena and to facts dating to recent geological past of the earth, and consequently the comparative method, so favored in natural sciences, can be applied here most successfully. This book gives the reader a survey of periglacial problems, which were considered, in every instance, in the comparative aspect: contemporary-Pleistocene periglacial zone. (Froehlich-ISWS) W79-05545

THE USE OF SNOWCOVERED AREA IN RUNOFF FORECASTS.

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. A. Rangó, J. F. Hannaford, R. L. Hall, M. Rosenzweig, and A. J. Brown.

Available from the National Technical Information Service, Springfield, VA 22161 as N78-16410. Price codes: A03 in paper copy, A01 in microfiche. NASA Technical Memorandum 78083, March 1977. 29 p, 5 fig, 4 tab, 4 ref. NAS5-22957.

Descriptors: *Remote sensing, *Snowmelt, *Runoff forecasting, *Water supply, Data collections, Snowpacks, Orography, Methodology, Statistical analysis, Investigations, *Snowcovered areas, *Sierra Nevada Mountains, Snowpack index, Precipitation index.

Long-term, snowcovered area data from aircraft and satellite observations were investigated for application to water supply forecasting in California's southern Sierra Nevada Mountains. These observa-

tions have proven useful in reducing seasonal runoff forecast error on the Kern River watershed when incorporated into procedures to update water supply forecasts as the melt season progresses. Similar use of snowcovered area on the Kings River watershed produced results that were about equivalent to methods based solely on conventional data. Snowcovered area will be most effective in reducing forecast procedural error on watersheds with: (1) a substantial amount of area within a limited elevation range; (2) an erratic precipitation and/or snowpack accumulation pattern not strongly related to elevation; and (3) poor coverage by precipitation stations or snow courses restricting adequate indexing of water supply conditions. When satellite data acquisition and delivery problems are resolved, the derived snowcover information should provide a means for enhancing operational streamflow forecasts for areas that depend primarily on snowmelt for their water supply. (Singh-ISWS) W79-05611

EASTERN-WESTERN ARCTIC SEA ICE ANALYSES.

Fleet Weather Facility, Suitland, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A043 353. Price codes: A10 in paper copy, A01 in microfiche. Report, 1976. 210 p, 104 fig.

Descriptors: *Sea ice, *Remote sensing, *Mapping, *Arctic, Satellites (Artificial), Ice cover, Ice, Temperature, Data collections, Data processing, Maps, Climatology, *Northern hemisphere.

The Navy has a long and colorful history of polar exploration and currently is an active participant in the growing national activity in the Arctic and Antarctic. The strategic importance and increased demand for the natural resources of these areas have resulted in a greater requirement for environmental information. The principal aim of this publication was to provide operators and researchers with historical weekly hemispheric analyses of sea ice conditions derived principally from satellite imagery supplemented by conventional observations for 1976. The charts were constructed by Navy ice analysts under operational time constraints from satellite imagery and conventional data. Reanalysis with late data was not normally attempted, but rather, the current analysis was prepared incorporating the late data to the extent possible. The analysis was compared with available climatology in an attempt to eliminate gross errors. Scanning radiometer imagery, visual and infrared, from the National Oceanic and Atmospheric Administration satellites and microwave radiometer data from the NIMBUS V research satellite were the primary data sources. (Sims-ISWS) W79-05613

LAKE ERIE ICE: WINTER 1975-76.

National Oceanic and Atmospheric Administration, Rockville, MD. Environmental Science Information Center. J. H. Wartha.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-276 386. Price codes: A05 in paper copy, A01 in microfiche. NOAA Technical Memorandum NESS 90, August 1977. 68 p, 39 fig, 3 ref, 1 append.

Descriptors: *Lake Erie, *Ice, *Data collections, *Remote sensing, Lakes, Ice cover, Movement, Satellites (Artificial), Climatic data, Meteorological data, Iced lakes, Surface waters, Spatial distribution.

This report included satellite data from the NOAA-4 VHR, National Oceanic and Atmospheric Administration's Geostationary Operational Environmental Satellite, and the National Aeronautics and Space Administration's Landsat. Canadian aerial ice reconnaissance, and aircraft Side Looking Airborne Radar systems. These data were used to trace the development, movement, and dissipation of lake ice from December 28, 1975 to April 19, 1976 at intervals of about 3 days. Wind speeds and directions were correlated with ice

movement, and air temperatures were related to ice formation and dissipation. Ice conditions were generally normal; however, ice persisted in the eastern end of the lake until mid-April. This unusually late date for clearing was caused more by winds concentrating the ice than by very cold weather. (Humphreys-ISWS) W79-05615

APPLICATION OF LANDSAT IMAGERY FOR SNOW MAPPING IN NORWAY.

Norges Vassdrags- og Elektrisitetsvesen, Oslo.

For primary bibliographic entry see Field 7B.

W79-05617

SNOW AND ICE IN THE PHOSPHORUS BUDGET OF A LAKE IN SOUTH CENTRAL ONTARIO.

Trent Univ., Peterborough (Ontario).

W. P. Adams, M. C. English, and D. C. Lasenby. Water Research, Vol. 13, No. 2, p 213-215, 1979. 1 fig, 2 tab, 9 ref.

Descriptors: *Phosphorus, *Canada, *Lakes, *Ice, *Snow, Nutrients, Precipitation (Atmospheric), Snowfall, Lake ice, Iced lakes, On-site investigations, Chemicals, Chemical analysis, Chemistry, Limnology, *Coon Lake (Ontario), *Ontario.

Roles of snow and various forms of ice in the phosphorus cycle of a lake were discussed. It was pointed out that precipitation falling directly onto a lake ice sheet during the winter has a disproportionately large impact on the lake system in the spring. Phosphorus derived from snow incorporated into the ice sheet must be included if accurate estimates of spring phosphorus loading are to be made. Data from Coon Lake, Ontario, were used to illustrate points made. (Sims-ISWS) W79-05620

A LARGE-SCALE NUMERICAL MODEL OF SEA ICE.

National Center for Atmospheric Research, Boulder, CO.

C. L. Parkinson, and W. M. Washington. Journal of Geophysical Research, Vol. 84, No. C1, p 311-337, January 20, 1979. 28 fig, 3 tab, 86 ref. NSF ATM76-08492.

Descriptors: *Sea ice, *Arctic, *Arctic Ocean, *Antarctic, *Antarctic Ocean, *Model studies, Mathematical models, Ice, Cold regions, Winds, Temperature, Air temperature, Water temperature, Humidity, Heat flow, Heat transfer, Freezing, Melting, Clouds, Atmosphere, Oceans, Simulation analysis.

Work at the National Center for Atmospheric Research has resulted in the construction of a large-scale, sea-ice model capable of coupling with atmospheric and oceanic models of comparable resolution. The sea-ice model itself simulated the yearly cycle of ice in both the northern and the southern hemispheres. Horizontally, the resolution was approximately 200 km, while vertically the model included 4 layers: ice, snow, ocean, and atmosphere. Both thermodynamic and dynamic processes were incorporated, the thermodynamics being based on energy balances at the various interfaces and the dynamics being based on the following 5 stresses: wind stress, water stress, Coriolis force, internal ice resistance, and the stress from the tilt of the sea surface. Although the ice within a given grid square was of uniform thickness, each square also had a variable percentage of its area assumed ice free. The model results produced a reasonable yearly cycle of sea-ice thickness and extent in both the Arctic and the Antarctic. The arctic ice grows from a minimum in September, when the edge has retreated from most coastlines, to a maximum in March, when the ice has reached well into the Bering Sea, has blocked the north coast of Iceland, and has moved southward of the southernmost tip of Greenland. Maximum arctic thicknesses are close to 4 m. In the Antarctic, the ice expands from a minimum in March to a maximum in late August, remaining close to the continent in the former month and

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extending northward of 60 deg S in the latter month. Maximum thicknesses are about 1.4 m. The distribution of modeled ice concentrations correctly revealed a more compact ice cover in the northern hemisphere than in the southern hemisphere. (Sims-ISWS)
W79-05632

PHYSICAL MEASUREMENT OF ICE JAMS, 1976-77 FIELD SEASON,
Army Terrestrial Sciences Center, Hanover, NH. Applied Research Branch.
J. L. Wuebben, and D. M. Stewart.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-053 260. Price codes: A03 in paper copy, A01 in microfiche. Special Report 78-3, March 1978. 21 p, 21 fig, 2 tab, 2 ref, 2 append.

Descriptors: *Ice jams, *Rivers, *Measurement, *Vermont, Ice, Streamflow, Runoff, Storms, Water levels, Profiles, Hydrographs, On-site investigations, On-site data collections, Ice cover, Winter, *Ottawaquechee River(VT).

Three shallow stream ice jams which occurred on the Ottawaquechee River in Vermont during the 1976-77 winter season were documented. Measurements of the variation in jam thickness along the longitudinal profile of the jams were given along with the variation in surface ice flow sizes. These measurements were compared with those of previous work. All jams were caused, to some extent, by backwater conditions in the river. The effects of an ice cover and the ice jams on the longitudinal water surface profiles were examined and compared with open water conditions. (Sims-ISWS)
W79-05833

MELTING OF ICE IN SEA WATER: A PRIMITIVE MODEL WITH APPLICATION TO THE ANTARCTIC ICE SHELF AND ICEBERGS,
Bergen Univ. (Norway). Geophysical Inst.
H. G. Gade.
Journal of Physical Oceanography, Vol. 9, No. 1, p 189-198, January 1979. 6 fig, 17 ref, 1 append.

Descriptors: *Ice, *Sea water, *Melting, *Model studies, Mathematical models, Temperature, Water temperature, Salinity, Oceans, Icebergs, Melt water, Mixing, Heat transfer, Oceanography.

Steady-state conditions are assumed to exist everywhere in the case of melting of the underside of an infinite slab of ice floating in seawater. Basic transfer equations for heat and salt were established, and solutions were derived for the interior corresponding to given far field values of the temperature and salinity of the water. The solutions were discussed in the T-S diagram where the behavior is particularly simple. Determining parameters are the characteristic velocities $k_{sub} s/d$ and $K_{sub} s/h$, where $k_{sub} s$ and $K_{sub} s$ are the molecular and turbulent diffusivities, respectively, of salt, and d and h are the thicknesses of the corresponding laminar and turbulent layers. Also, the nonmelting/nonfreezing case was discussed, and the determining parameter was established. Application of the theory to the Ross Ice Shelf (Little America V) gave acceptable results, with $d = 0.002$ m and $K_{sub} s = 0.002 - 0.003$ sq m/s. Analysis of the static stability of the meltwater mixtures revealed that with ambient temperatures approaching 17C, the stratification becomes unstable. Icebergs brought to tropical waters will cause meltwater mixtures to intrude at subsurface levels. Finally, convection obtained in laboratory experiments with melting ice in seawater was reported to be in concordance with the theoretically derived stability criterion. (Sims-ISWS)
W79-05857

RIVER ICE,
Army Terrestrial Sciences Center, Hanover, NH. Snow and Ice Branch.
G. D. Ashton.
American Scientist, Vol. 67, No. 1, p 38-45, January-February 1979. 9 fig, 21 ref.

Descriptors: *Ice, *Rivers, *Ice cover, *Ice jams, Frazil ice, Freezing, Heat balance, Ice/water interfaces, Analytical techniques, Heated water, Ripple marks, Melting, Ice formation, Ice thickening, Ice ripples.

The presence of ice on rivers changes the behavior of rivers, interferes with their use, and causes severe economic disruption. River ice may be characterized as a series of quasi-steady states that exist between short periods of intense change. These short periods, while most significant in establishing the next steady state, are also the most difficult to observe, predict, and understand. This paper discussed frazil ice formation, thickening of ice cover, ice ripples and rotting of ice cover, ice jams, and effects of thermal effluents. Many subtopics were not touched upon in this brief overview, including ice-retention structures, forces due to ice action, winter navigation in ice-covered rivers, and mechanical properties of ice. The Cold Regions Research and Engineering Laboratory has just completed construction of a major facility for the study of many of the subjects discussed. Recently, the development of a pulsed-radar system has provided a means to measure ice thicknesses remotely without recourse to physical penetration and measurement, and it will allow acquisition of the all-important field data necessary to verify laboratory and analytical findings. (Humphreys-ISWS)
W79-05860

2D. Evaporation and Transpiration

EQUILIBRIUM AND ACTUAL EVAPOTRANSPIRATION FROM A VERY DRY VEGETATED SURFACE,
British Columbia Ministry of the Environment, Kamloops.
R. J. Williams, K. Broersma, and A. L. van Ryswyk.

Journal of Applied Meteorology, Vol. 17, No. 12, p 1827-1832, December 1978. 3 fig, 1 tab, 17 ref.

Descriptors: *Equilibrium, *Evapotranspiration, *Vegetation, *Canada, Energy budget, Grasses, Measurement, Range grasses, Climatic data, Latent heat, Soil moisture, Model studies, *Vegetated surface, *Actual evapotranspiration, *British Columbia, *Kamloops(British Columbia), Equilibrium evapotranspiration, Equilibrium model.

Energy balance measurements of evapotranspiration from very dry, seeded, rangeland grass near Kamloops, British Columbia, were compared with daily equilibrium evapotranspiration estimates. The equilibrium model was found to overestimate evapotranspiration from all sites at rates much less than potential. The data indicated by extrapolation that the accepted proportionality factor alpha value of 1.26, as reported by Priestly and Taylor, is confirmed at the lower limit of potential evapotranspiration. An attempt to select values of the proportionality factor alpha to the first power, for nonpotential conditions, as a function of surface soil moisture proved to be inadequate. An attempt to establish a relationship between alpha to the first power and soil moisture in the entire root zone was also unsuccessful. (Roberts-ISWS)
W79-05529

COMPARISON OF EVAPOTRANSPIRATION RATES IN THE PLATTE RIVER IN NEBRASKA: 1938 VS 1978,
Kearney State Coll., NE.
H. G. Nagel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 265. Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center, University of Nebraska, Lincoln Project Completion Report, February 1979. 36 p, 12 fig, 5 tab. OWRT A-059-NEB(1). 14-34-0001-8029.

Descriptors: *Evapotranspiration, *Platte River, Evaporation, Riparian vegetation, Forests.

A computational model was developed to estimate evapotranspiration (ET) in the Platte River ecosys-

tem of Central Nebraska. Data used in the model were mostly derived from the literature, although leaf temperature data were collected to estimate species transpiration coefficients. Preliminary estimates for ET are 35.3 inches/year during the April to October growing season. Riparian forest accounted for 30% of the total ET, followed in order of importance by open water evaporation, forested islands, herbaceous riparian transpiration, sandbar evaporation and then herbaceous island vegetation, which accounted for only 10% of the total ET. The Platte River has changed markedly during the last 40 years, with reduced flows and narrowed channel width. Much riparian forest has grown up in that time, and vegetated islands occupy a greater percentage of the remaining channel than previously. A comparison of ET rates between the 1930's and 1970's was attempted, using the computational model developed. Total ET rates in the 1930's were about the same as today (37/3 inches/year), but proportion by habitat differed greatly, with open water evaporation probably accounting for about half the total ET then.
W79-05798

AN ANALYTICAL MODEL OF RAINFALL INTERCEPTION BY FORESTS,
Institute of Hydrology, Wallingford (England).
J. H. C. Gash.
Quarterly Journal of the Royal Meteorological Society, Vol. 105, No. 443, p 43-55, January 1979. 3 fig, 1 tab, 22 ref.

Descriptors: *Rainfall, *Interception, *Forests, *Evaporation, *Model studies, Deciduous forests, Hardwood, Precipitation(Atmospheric), Mathematical models, Regression analysis, Equations, Trees, Canopy, Wetting, On-site investigations, *Thetford Forest(East Anglia), *Great Britain.

The description of the evaporation of rainfall intercepted by forests in terms of a regression of evaporation loss on incident rainfall was discussed, and some of the assumptions implicit in that method were re-examined. The 2 major factors which control the evaporation of intercepted rainfall were identified: (1) the amount of time that the canopy spends saturated during rainfall and the evaporation rate applicable under these conditions; and (2) the canopy saturation capacity and the number of times this store is emptied by drying out after the cessation of rainfall. A model was constructed which is conceptually similar to the Rutter model, but which replaces that model's numerical approach with an analysis by storm events. The evaporation from a saturated canopy during rainfall was estimated from the Penman-Monteith equation; the following were added as separate terms: evaporation after rain has ceased, the effect of small storms insufficient to saturate the canopy, wetting-up the canopy, and evaporation from the trunks. The model was tested against data from Thetford Forest in East Anglia, with satisfactory agreement between observation and estimation. It was suggested that the model may be capable of making useful estimates of the evaporation of intercepted rainfall solely from rainfall measurements. (Sims-ISWS)
W79-05854

2E. Streamflow and Runoff

SUPERCritical FLOW IN BENDS OF TRAPEZOIDAL SECTION,
Missouri Univ., Columbia, Dept. of Civil Engineering.
C. W. Lennau.

Journal of Engineering Mechanics Division, American Society of Civil Engineers, Proceedings Paper 14369, Vol. 105, No. EM1, p 43-54, February 1979. 4 fig, 10 ref, 2 append.

Descriptors: *Open channel flow, *Steady flow, *Supercritical flow, Elevation, Hydraulics, Flow, Equations, Cross-sections, Channels, Peak discharge, Mathematical studies, Hydraulic bends, Inviscid flow, Trapezoidal channels.

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Steady supercritical flow in circular bends of trapezoidal cross section was analyzed for the case in which the radius of curvature of the center line is much larger than the undisturbed depth of flow h sub 0. Supercritical flow in bends of trapezoidal cross section was analyzed for the case relative curvature less than 1 and Froude number greater than 2. It was found that an almost periodic pattern of crests exists along the outside edge. This pattern is exactly matched in magnitude and position by a pattern of depressions along the inside edge. The crests along the outside edge rise from near the undisturbed flow elevation to a maximum value and back down again. (Lee-ISWS)
W79-05531

SIMPLIFIED MUSKINGUM ROUTING EQUATION,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. M. Ponce.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY1, Technical Note, p 85-91, January 1979. 2 fig, 1 tab, 10 ref, 2 append.

Descriptors: *Flood routing, *Flood waves, *Mathematical models, Routing, Analytical techniques, Model studies, Channels, Rivers, Equations, Discharge(Water), Flood flow, Hydrograph analysis.

The Muskingum method and its variations are well established in the flood routing literature. Traditionally, its parameters K and X have been determined by calibration using measured inflow and outflow hydrographs. An improved version is due to Cunge, who showed that parameters K and X could be related to the physical problem, thus eliminating the need for trial and error calibration while at the same time enhancing the predictive capabilities of the method. With the aid of Cunge's findings, the calculations can proceed either in a lumped parameter mode, or in a variable parameter mode. The lumped parameter mode has simplicity as its major advantage, although this is achieved at the cost of a certain loss in detail. A simplified Muskingum routing equation was developed. The method is based on the specification of the space and time intervals Δx and Δt such that $X = 0$ and $K = \Delta t$. In this case, the routing equation reduces to the computation of a simple average. Testing of the method showed that reasonably accurate results can be obtained with a minimum of computational effort. (See also W70-04590) (Humphreys-ISWS)
W79-05536

FLOW PROFILES IN TRAPEZOIDAL CHANNELS BY POCKET CALCULATORS,

Public Power Corp., Athens(Greece). Computing Center.

For primary bibliographic entry see Field 8B.
W79-05538

SUBSIDENCE OF PEAK FLOW IN CHANNELS WITH STORAGE AREAS,

National Taiwan Univ., Taipei. Dept. of Civil Engineering.
C-L. Yen.

Journal of Hydraulic Research, Vol. 16, No. 4, p 309-326, 1978. 11 fig, 3 tab, 7 ref.

Descriptors: *Channel flow, *Peak discharge, *Subsidence, *Model studies, Mathematical models, Simulation analysis, Numerical analysis, Flow, Storage, Floods, Flood plains, Vegetation effects, Hydrographs, Discharge(Water), Streamflow, Hydraulics, Subsidence functions, Storage areas.

Subsidence of peak flow in channels with storage areas having no significant longitudinal flow was investigated. Numerical simulation of unsteady flow was used for various sizes of storage area and flow conditions. Based on the results of numerical simulation, a subsidence function was defined and expressed as an exponential function of a parameter combining relative size of storage area, peak

inflow, and other flow and channel factors. The coefficients in the subsidence function also were evaluated from the results of numerical simulation. Testing of the subsidence function with one set of field data yielded reasonably good results. However, further testing with more field data was recommended. (Sims-ISWS)
W79-05541

RIVER RUNOFF REGULATION AND WATER-MANAGEMENT CALCULATIONS, (METODIKA REGULIROVANIYA STOKA I VODOKHOZYAISTVENNYKH RASCHETOV),

For primary bibliographic entry see Field 4A.
W79-05544

GEOHYDROLOGICAL RESEARCH AT THE CHALMERS UNIVERSITY OF TECHNOLOGY, GÖTEBORG.

For primary bibliographic entry see Field 4C.
W79-05546

SOME RESULTS FROM URBAN RUNOFF STUDIES IN BERGSJÖN GÖTEBORG,

Chalmers Univ. of Technology, Göteborg (Sweden). Dept. of Hydraulics.

For primary bibliographic entry see Field 2A.
W79-05548

APPLICATION OF HYDRAULIC AND HYDROLOGIC DATA IN URBAN STORMWATER MANAGEMENT,

Geological Survey, Oklahoma City, OK. Water Resources Div.

For primary bibliographic entry see Field 6A.
W79-05588

SELECTED LOW-FLOW CHARACTERISTICS OF STREAMS IN THE VICINITY OF WARWICK, ORANGE COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.

B. B. Eisler.
Geological Survey open-file report 78-811, 1978. 21 p, 1 fig, 3 tab, 5 ref.

Descriptors: *Low flow, *Streamflow, *Base flow, *New York, *Streams, Flow characteristics, Data collections, Flow rates, *Orange County(NY), *Warwick area(NY).

Base flows were measured during 1971-76 at 10 partial-record sites and three continuous-record stations on major streams in and bordering the town of Warwick, N.Y. Discharge measurements at the partial-record sites were correlated with records from three suitable continuous-record gaging stations near the town to determine 7-day, 2 year low flows and 7-day, 10-year low flows. Measurement-site descriptions are included. The information provides a data base that planners and managers can use in making water-management decisions. (Woodard-USGS)
W79-05595

REVIEW REPORT ON UMPQUA RIVER AND TRIBUTARIES, OREGON, INTERIM REPORT, SOUTH UMPQUA RIVER, VOLUME III; (APPENDIX B-HYDROLOGY, METEOROLOGY, AND RESERVOIR REGULATION; APPENDIX C-FOUNDATION AND MATERIALS DATA; APPENDIX D-RECREATION, PUBLIC USE, AND ENVIRONMENT),

Army Engineers District, Portland, OR.

For primary bibliographic entry see Field 8A.

W79-05616

STORMWATER INTERCEPTION AND STORAGE,

Hydroscience, Inc., Westwood, NJ.

D. M. Di Toro, and M. J. Small.
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol. 105, No. EE1, Proceedings Paper 14368, p 43-54, February 1979. 7 fig, 2 tab, 18 ref, 2 append.

Descriptors: *Combined sewers, *Storm runoff, *Storm water, *Water storage, Statistical analysis, Water pollution, Water treatment, Retention, Interceptor sewers, Flow, Runoff, Model studies, Duration curves.

Stormwater control devices are constructed to intercept or to capture a portion of the design storm with a given runoff flow and duration. The portion will change, however, as the characteristics of the runoff vary from storm to storm. A statistical method of analysis was described. The method is based on a probabilistic characterization of rainfall and runoff, which evaluates the long-term performance efficiency of the devices. Stormwater control devices that capture and store runoff include interceptors and retention basins. The long-term average performance of interceptors and storage devices is determined based on the size and operational mode of the devices and the statistical properties of the runoff. Issues addressed included the effect of previous storms on storage, the emptying rate of the basin, flow variations between and within storms, the treatment implications of the first flush effect, and flow-concentration correlations. (Visocky-ISWS)
W79-05625

A STATISTICAL STUDY OF THE ANNUAL RAINFALL IN THE SUTLEJ CATCHMENT AND ANNUAL RUN-OFF AT BHAKRA DAM SITE,

Meteorological Office, New Delhi (India).

For primary bibliographic entry see Field 2B.
W79-05628

A STUDY OF LARGE FLOODS IN THE THAMBRAPARANI RIVER IN TAMIL NADU,

Observatory, New Delhi (India).

V. S. Rao, and C. Ramaswamy.

Indian Journal of Meteorology, Hydrology, and Geophysics, Vol. 27, No. 3, p 253-262, July 1976. 8 fig, 5 tab, 10 ref.

Descriptors: *Floods, *Precipitation excess, *Rainfall, Historic floods, Flash floods, Flood data, Hydrographs, Isohyets, Weather data, Runoff, Discharge(Water), Storms, Warning systems, Meteorology, Hydrology, *India, *Thambraparan River(India).

The paper contained an analysis of 16 synoptic situations during the period 1891-1960 (70 years) over and near the Gulf of Mannar in which prima facie, there could have been very heavy rain and consequent large floods in the Thambraparan River in the extreme south of the Indian Peninsula. It was found that there were only 3 situations in which 24-hour rainfall exceeding 200 millimetres at any one station in the river catchment was recorded. In all these 3 cases, there were large floods in that river. The basic synoptic causes for these 3 occasions of large floods were investigated in detail. Hydrological data pertaining to these 3 flood-situations were obtained from the Government of Tamil Nadu in the proforma prescribed by UNESCO for compiling information about catastrophic floods. Discharge-hydrographs based on the available data were prepared and studied. Isohyetal analysis for a one-day and two-day rainstorm was carried out. The hydrological characteristics of the floods so far as these could be determined from the available flood-data were discussed. All the 3 cases of large floods could be termed as 'flash floods'. The factors which led to the very heavy rainfall and flash floods were discussed from the point of view of issue of heavy rainfall and flood warnings on a quasi-empirical basis. (Sims-ISWS)
W79-05629

NITROGEN AND CHLORIDE MOVEMENT IN SMALL UPLAND PIEDMONT WATERSHEDS: II. NITROGEN AND CHLORIDE TRANSPORT IN RUNOFF,

Southern Piedmont Conservation Research Center, Watkinsville, GA.

For primary bibliographic entry see Field 5B.
W79-05642

Field 2—WATER CYCLE

Group 2E—Streamflow and Runoff

SPECIAL FLOOD HAZARD INFORMATION: TURKEY CREEK, BRYAN, TEXAS.
Prepared for the City of Bryan, Texas, December 1975, 17 p, 1 fig, 3 plates, 2 tab.

Descriptors: *Floods, *Texas, *Flooding, *Turkey Creek(TX), *Bryan(TX), *Flood protection, Runoff, Floodwater, Regional flood, Indirect flood measurement, Flood profiles, Historic floods, Flood stages, Peak discharge, Rivers, River beds, Floodways, Flood plains, Flood plain management, Flood plain zoning, Building codes, Land use, Planning, Zoning, Control structures, Floodproofing, 100-year flood, Flood data.

This report provides information about the flood potentials of 6.3 river miles of Turkey Creek and its South Fork in the vicinity of Bryan, TX, in Brazos County, about 70 miles northwest of Houston. Development in the flood plain is mainly agricultural. There are no stream gauging stations in the study area, and little specific data are available on past floods. Nearby Carters Creek appears to have experienced flooding in 1900, 1947, 1960, and 1973, and it is assumed flooding also occurred along Turkey Creek. Natural obstructions include trees, brush, and other vegetation in the floodway area. The 100-year flood would discharge 6,200 cubic feet per second (cfs) at London Bridge. No existing flood control structures exist on these two streams. A series of proposed guidelines for floodplain management include selective zoning measures which clearly define the floodway zone, subdivision regulations, changes in building codes to improve structural integrity, floodproofing, health regulations to control sewage disposal during floods, more accurate and timely forecasting of floods, and policies which discourage development in the floodway and the adjacent flood fringe. (Arnold-NC)
W79-05716

FLOOD PLAIN INFORMATION: MAXWELL CREEK, PARKER, TEXAS.
Army Engineer District, Fort Worth, TX.
Prepared for The City of Parker, Texas, February 1977. 34 p, 6 fig, 14 plates, 7 tab.

Descriptors: *Floods, *Flood stages, *Texas, *Peak discharge, *Flood plain management, *Flood protection, *Collin County(TX), *Maxwell Creek(TX), *Flooding, Flood flow, Indirect flood measurement, Flood forecasting, Historic floods, Flood data, Flood frequency, Stage-discharge relations, Rivers, Flood plains, Non-structural alternatives, Flood plain zoning, Flood plain insurance, Building codes, Land use, Planning, Zoning, Control structures, Flow control, Floodproofing, Parker(TX), 100-year flood, 500-year flood.

This report presents the flood profile and potential flood hazards in the 10.52 square mile Maxwell Creek watershed in the vicinity of Parker, TX, northeast of the Fort Worth-Dallas metropolitan area. The flood plain is primarily undeveloped, with a few scattered residential sites. There are no stream gaging stations in the study area. However, U.S. Geological Survey stream gages in the Fort Worth-Dallas area were used for flood profiles for this study. Most flooding occurs in spring and fall, caused by heavy rains from storms and hurricanes. Obstructions include heavy tree, brush, and vegetation growth in the floodway. Four large floods occurred in 1968, 1969, 1971, and 1975. Estimated peak discharges at the downstream confluence with Small Tributary would be 11,300 cubic feet per second (cfs) for the 100-year flood, and 14,400 cfs for the 500-year flood. Recommended guidelines for flood plain management control include institution of regulatory measures, such as flood plain zoning, subdivision control ordinances, building and health codes; and establishment of nonregulatory measures, such as structural control barriers, fee purchase of flood plain lands for open space, acquisition of flooding easements, floodproofing, waterproofing and filling, establishment of a flood insurance program, and establishing development policies to control the extension of public services into flood hazard zones. (Arnold-NC)
W79-05719

FLOOD PLAIN INFORMATION: DEER CREEK AND TRIBUTARIES, CROWLEY, TEXAS.

Army Engineer District, Fort Worth, TX.
Prepared for The City of Crowley, Texas, October 1977, 41 p, 7 fig, 25 plates, 7 tab.

Descriptors: *Texas, *Floods, *Flood profiles, *Flood stages, *Flood protection, *Flood plain management, *Crowley(TX), *Deer Creek(TX), Runoff, Regional flood, Indirect flood measurement, Flood forecasting, Historic floods, Flood data, Peak discharge, Flood peak, Non-structural alternatives, Flood plain zoning, Flood plain insurance, Warning systems, Building codes, Land use, Planning, Zoning, Control structures, Levee, Dikes, Dams, Tarrant County(TX), 100-year flood, 500-year flood.

The study area encompasses 18.1 miles of Deer Creek and its tributaries in the vicinity of Crowley, TX, just south of the Fort Worth-Dallas metropolitan area. Drainage area at the mouth of Deer Creek is 21.42 square miles. Average streambed slope varies from 20.7 feet/mile (at mouth of Deer Creek) to 75.3 feet/mile (at mouth of West Fork). The flood plains are primarily undeveloped, with a few scattered residential and commercial sites. Proximity to the City of Fort Worth will lead to intensified flood plain development. There are no stream-gaging stations in the area, although U.S. Geological Survey stream gages in the Fort Worth area were used for comparison purposes. Causes of flooding have been largely storms occurring in the spring and fall. Trees, brush, and debris are the chief impediments to floodflow. The most serious flooding occurred in spring 1949, 1957, and 1969. Peak discharges for the 100-year flood at the mouth of Deer Creek would be 19,700 cubic feet per second (cfs), and for the 500-year flood, peak discharge would be 25,700 cfs. There are no major flood damage prevention measures in the study area. Recommendations include establishment of flood plain regulatory measures, and nonregulatory measures such as acquiring flood plain lands for open space use and establishing a flood insurance program. The report is intended as an aid in planning the best use of flood-prone areas. (Arnold-NC)
W79-05720

MONITORING AREA-WIDE RURAL WATER QUALITY.

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5A.
W79-05842

CLASSIFICATION OF EVALUATION OF FLOOD FLOW FREQUENCY ESTIMATION TECHNIQUES.

Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen, and W. J. Rawls.
Water Resources Bulletin, Vol. 15, No. 1, p 88-93, February 1979. 19 ref.

Descriptors: *Flood frequency, *Application methods, *Data collections, Floods, Evaluation, Reviews, Model studies, Publications, Classification, Flow, Statistical methods, *Ungeared areas, Literature evaluation, Deterministic models, Calibrations.

Many procedures are available for estimating the magnitude and frequency of floods at ungauged locations. In selecting a procedure, a user considers the accuracy, reproducibility, and practicality of the available procedures. A classification system that groups the procedures according to important characteristics will be of great help to the user in selection of a suitable technique. The classification system, adapted by the Work Group on Flood Frequency Estimation at Ungauged Areas under the direction of the Hydrology Committee of the U.S. Water Resources Council, has 8 categories. It was recommended that the presentation of hydrologic studies should follow a consistent set of guidelines, including information relating to the accuracy, reproducibility, and practicality of the procedure

used. Data requirements and the assumptions need to be clearly spelled out. (Singh-ISWS)
W79-05844

THE EFFECT OF THE SMALL-SLOPE APPROXIMATION AND LOWER BOUNDARY CONDITIONS ON SOLUTIONS OF THE SAINT-VENANT EQUATIONS.

Institute of Hydrology, Wallingford (England).
E. M. Morris.
Journal of Hydrology, Vol. 40, No. 1/2, p 31-47, January 1979. 10 fig, 13 ref.

Descriptors: *Hydrology, *Hydrographs, *Model studies, *Mathematical models, Equations, Streamflow, Runoff, Overland flow, Rainfall, Precipitation(Atmospheric), Froude number, Flow, Slopes, Waterheads(Basins), Mathematics.

A new, implicit, finite difference scheme was used to investigate the effect of the small slope approximation and the choice of lower boundary conditions on solutions of the Saint-Venant equations. It was found that for a range of values of the Froude and kinematic wave numbers, which covers most cases of hydrological interest, these factors have no significant effect on the depth and velocity profiles for surface flow. (Sims-ISWS)
W79-05938

TRANSLATORY CHARACTERISTICS OF THE MUSKINGUM METHOD OF FLOOD ROUTING.

Ahmadu Bello Univ., Zaria (Nigeria), Dept. of Civil Engineering.
M. A. Gill.
Journal of Hydrology, Vol. 40, No. 1/2, p 17-29, January 1979. 4 fig, 1 tab, 12 ref.

Descriptors: *Flood routing, *Floods, *Flood waves, Storage coefficient, Hydrology, Hydraulics, Equations, Mathematical studies, Streams, Storage, Waves(Water), Analysis, *Muskingum method, Translatory characteristics, Sinusoidal flood.

Translatory characteristics of the routed flood waves using the Muskingum method were examined. It was possible to remove some ambiguities of the earlier work on the Muskingum method. Particularly for instance, the occurrence of the negative outflows during the time intervals 0 less than t less than k was explained as due to the use of wrong initial condition. As such, the method itself is free from this defect. (Lee-ISWS)
W79-05941

A SUMMARY OF MEASURED HYDRAULIC DATA FOR THE SERIES OF STEADY AND UNSTEADY FLOW EXPERIMENTS OVER UNIFORM GRASS ROUGHNESS.

Geological Survey, NSSL Station, MS. Water Resources Div.
D. L. Collins, and K. M. Flynn.
Geological Survey open-file report 78-808 (basic data), July 1978. 826 p, 2 fig, 66 tab.

Descriptors: *Flood plains, *Open channel flow, *Steady flow, *Unsteady flow, *Roughness(Hydraulic), Streambeds, Grassed waterways, Flow rates, Flow characteristics, Channel morphology, Elevation, Hydrographs, Hydrologic data, Analytical techniques, *Flood Plain Simulation Facility(MS), *Bay St. Louis(MS), Uniform grass roughness.

The measured hydraulic data collected in the Flood Plain Simulation Facility located at the Gulf Coast Hydrosience Center, near Bay St. Louis, Miss., are summarized for a series of experiments designed to study steady and unsteady flow over uniform grass roughness. All experiments were conducted during the 1973 and 1974 test seasons. Tables of measured ground-surface elevations, water-surface elevations, and point velocities are included for all experiments. A total of 19 steady flow experiments and 7 unsteady flow experiments for varying grass heights are included. The tabulated point velocities and water-surface elevations for

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the unsteady flow experiments were selected to represent the general changes in the flow variables as the flood wave passed through the facility but do not include all collected data. However, all data that were collected have been stored on computer disk storage and may be retrieved using the listing programs and memory locations. (Woodard-USGS) W79-05966

RESIDUE AND TILLAGE EFFECTS ON SCS RUNOFF CURVE NUMBERS.

Science and Education Administration, Beltsville, MD. Hydrology Lab.
W. J. Rawls, and C. A. Onstad.
Paper No. 78-2505, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois. 18 p, 5 fig, 7 tab, 22 ref. ASAE, St. Joseph, Michigan.

Descriptors: Runoff, Surface runoff, Soil conservation, Till, Rainfall, Simulated rainfall, Estimating, Small watersheds, Corn(Field), Grains(Crops).

Data from 525 simulated and natural rainfall events were used to develop guides for estimating the effect of conservation tillage practices on the SCS runoff curve numbers for corn and small grain. The amount of residue on the ground or the percent of surface covered with residue was used to represent the effect of conservation tillage practices. (Skogerboe-Colorado State) W79-05980

FLOOD-PLAIN DELINEATION FOR OCCOQUAN RIVER, WOLF RUN, SANDY RUN, ELK HORN RUN, GILES RUN, KANES CREEK, RACON CREEK, AND THOMPSON CREEK, FAIRFAX COUNTY, VIRGINIA.
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 6A. W79-05986

2F. Groundwater

EVALUATION OF PROPOSED TG AND E (TUCSON GAS AND ELECTRIC COMPANY) WASTEWATER DISCHARGE ON GROUNDWATER IN THE TUCSON BASIN.
Ground-Water Quality Consultant, Fresno, CA.
For primary bibliographic entry see Field 5E. W79-05519

GROUNDWATER SAMPLING IN URANIUM RECONNAISSANCE.
Union Carbide Corp., Oak Ridge, TN. Nuclear Div.
For primary bibliographic entry see Field 5A. W79-05521

HYDROLOGY AND WATER CONTROL ON LARGE PLAINS.
National Water Authority, Budapest (Hungary). Dept. of Water Resources Development.
For primary bibliographic entry see Field 2A. W79-05526

GEOHYDROLOGICAL RESEARCH AT THE CHALMERS UNIVERSITY OF TECHNOLOGY, GÖTEBORG.
For primary bibliographic entry see Field 4C. W79-05546

ESTIMATION OF TRANSMISSIVITY AND PERMEABILITY IN SWEDISH BEDROCKS.
Chalmers Univ. of Technology, Göteborg (Sweden).
L. Carlsson, and A. Carlstedt.
In: Geohydrological Research at the Chalmers University of Technology, Göteborg; Papers Presented at the Nordic Hydrological Conference in Reykjavik, August 29 to September 1, 1976, p 42-

54, May 1977. 6 fig, 4 tab, 14 ref.

Descriptors: *Transmissivity, *Permeability, *Bedrock, Specific capacity, Pumping, Wells, Water wells, Aquifers, Groundwater, Drawdown, Rocks, Foreign research, Sandstones, Limestones, Geology, Hydrogeology, *Sweden.

An estimation of the transmissivity and permeability in 4 different regions in Sweden with 7 different bedrocks was made from statistical analysis of pumped wells. The effect of well-loss in the calculation was treated theoretically. Of the investigated bedrocks, the permeability was highest in Cambrian and Algonkian sandstones. In the investigated crystalline Archean rocks, the gneisses seemed to have a better permeability than the granites, but the influence of the tectonic was very pronounced. (See also W79-05546) (Sims-ISWS) W79-05551

INJECTION OF WATER INTO WELLS FOR INVESTIGATION OF LIMITED AQUIFER.
Chalmers Univ. of Technology, Göteborg (Sweden).

For primary bibliographic entry see Field 4B. W79-05552

TRITIUM DATING OF SOME GROUNDWATER SAMPLES FROM NORTHWESTERN IRAQI DESERT.

Nuclear Research Inst., Baghdad (Iraq); Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo (Egypt).
A. S. Al-Badri, and F. M. Swaileem.
Journal of the Geological Society of Iraq, Vol. 8, p 1-5, 1975. 2 tab, 9 ref.

Descriptors: *Radioactive dating, *Aquifer systems, *Groundwater movement, *Tritium, *Iraq, Base flow, Recharge, Water sources, Water wells, Hydrogeology, Chemical analysis.

The use of tritium, a radioactive isotope of hydrogen, in the determination of groundwater age, is an important and useful tool in the establishment of recharge source, interconnections of aquifers, groundwater flow patterns and aquifer parameters. The present study was carried out as a joint project by the Iraqi Atomic Energy Commission and the Middle Eastern Regional Radioisotope Center in the Rutba area to determine these characteristics of some selected groundwater samples from the northwestern desert area of Iraq. Preliminary to this analysis, three spiked samples of known tritium quantity were brought from the U.S. for calculation of an enrichment factor and old samples from an oil field were used for background measurements. Thirteen water samples were then collected from different wells within the study area. Two recent samples from the Euphrates River and a snowfall in the area of Rutba were analyzed as a reference for these samples. Results were tabulated by locality, date of collection, and tritium content. The average values of tritium content in the samples was found to be + or - 328 tritium unit and the water from the Tunif Well was found to be the oldest water in the area, indicating a distant recharge source. Water from Amig and Gadeed Wells was found to be old but mixed with some recent water, while samples from the Al-Mat and Al-Rutba Wells were established as being new and mainly fed from rainwater derived from Mullusa formation. Swab and Er-Radhuma water was also found to be recent but mixed with some old water. (Tikes-Arizona) W79-05569

HYDROLOGIC DATA FOR THE ANTLERS AQUIFER, SOUTHEASTERN OKLAHOMA.
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2A. W79-05590

GROUND-WATER DATA ON THE HUDSON RIVER BASIN, NEW YORK.
Geological Survey, Albany, NY. Water Resources

Div.

D. S. Hammond, R. C. Heath, and R. M. Waller.
Geological Survey open-file report 78-710, 1978. 18 p, 2 fig, 1 plate, 1 tab, 30 ref.

Descriptors: *Groundwater resources, *Aquifers, *Groundwater availability, *Water quality, *Well data, Water wells, Water yield, Water levels, Unconsolidated aquifers, Chemical analysis, Hardness(Water), Dissolved solids, Chlorides, Sulfates, Bicarbonates, New York, *Hudson River basin.

Ground water in the Hudson River basin occurs in unconsolidated deposits and consolidated rock. Sand and gravel units of the unconsolidated deposits, which occur principally in valley bottoms, form the best aquifers and commonly provide well yields of several hundred gallons per minute. Carbonate aquifers are the most productive consolidated rock units. Ground water in the Hudson River basin is generally hard and may contain appreciable amounts of iron, salts in solution, or sulfur locally. Basic data on the availability of ground water in the Hudson River drainage area are compiled in (1) a hydrogeologic map of the drainage basin; (2) a table of well depths, yields, concentrations of selected chemical constituents, and hardness of ground water, listed by county and aquifer type; (3) a short text describing the occurrence of ground water in the basin; and (4) a bibliography of ground-water reports pertinent to the area studied. (Woodard-USGS) W79-05591

HYDROLOGIC DATA FOR WATER-TABLE AQUIFERS IN THE BOULDER-FORT COLLINS-GREELEY AREA, FRONT RANGE URBAN CORRIDOR, COLORADO.
Geological Survey, Lakewood, CO. Water Resources Div.

For primary bibliographic entry see Field 7C. W79-05594

THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER IN MISSISSIPPI.
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C. W79-05597

SELECTED WATER-LEVEL RECORDS FOR OKLAHOMA, 1975-1977.
Geological Survey, Oklahoma City, OK. Water Resources Div.; and Oklahoma Water Resources Board, Oklahoma City.
R. L. Goemaat, and D. E. Spiser.
Geological Survey open-file report 78-721, October 1978. 54 p.

Descriptors: *Oklahoma, *Water wells, *Water levels, *Aquifers, *Water level fluctuations, Basic data collections.

A systematic program to collect water-level records in Oklahoma began in 1937. The objectives of this program are (1) to provide long-term records of water-level fluctuations in representative wells, (2) to facilitate the prediction of water-level trends and indicate future availability of ground-water supplies, and (3) to provide information for use in basic research. This report includes a table of ground-water-level measurements in selected wells throughout Oklahoma for 1975-77. The data are subdivided by counties. (Woodard-USGS) W79-05604

GROUND-WATER LEVELS AND QUALITY DATA FOR GEORGIA, 1977.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 4B. W79-05607

GROUND-WATER RESOURCES OF THE PAROWAN-CEDAR CITY DRAINAGE BASIN, IRON COUNTY, UTAH.

Field 2—WATER CYCLE

Group 2F—Groundwater

Geological Survey, Salt Lake City, UT. Water Resources Div.
L. J. Bjorklund, C. T. Samsion, and G. W. Sandberg.
Utah Department of Natural Resources Technical Publication No. 60, 1978. 93 p, 17 fig, 8 plates, 10 tab, 44 ref.

Descriptors: *Groundwater resources, *Groundwater availability, *Water yield, *Aquifer characteristics, *Water quality, Hydrogeology, Surface-groundwater relationships, Water supply, Water utilization, Water demand, Irrigation, Water wells, Water level fluctuations, Hydrologic budget, Hydrologic data, Hydrographs, Maps, *Utah, *Iron County(Utah), *Parowan-Cedar City drainage basin.

This report is intended to assist public officials and water users in the Cedar City-Parowan drainage basin, Iron County, Utah, to develop, conserve, and administer their water resources. The report primarily describes the ground-water resources in the alluvial fill of Cedar City and Parowan Valleys, but it also presents information about the water in the bedrock formations in the highlands surrounding the valleys. It discusses the relation of ground water to surface water in the basin and presents a general water-budget analysis. It includes information on the source, occurrence, availability, quantity, movement, chemical quality, and development of the ground water and the effects of climate, geology, and development on the resource. Ground-water development during 1940-74 has resulted in depressed water levels in most of Parowan and Cedar City Valleys. The estimated average annual depletion of the ground-water reservoir is about 3,600 acre-feet in Parowan Valley and 3,300 acre-feet in Cedar City Valley. Pumpage during 1974 amounted to approximately 73,000 acre-feet-30,700 in Parowan Valley and 42,300 in Cedar City Valley. The ground-water resource in the heavily pumped areas of the valleys should be regarded as fully developed so far as large discharges are concerned. Some additional development in outlying areas may be feasible. (Woodard-USGS)
W79-05608

THE TRANSMISSIVITY ITERATIVE CALCULATION ROUTINE—THEORY AND NUMERICAL IMPLEMENTATION.
Battelle Pacific Northwest Labs., Richland, WA. Water and Land Resources Dept.
For primary bibliographic entry see Field 7C.
W79-05614

NITRATE MOVEMENT IN A CHILEAN AGRICULTURAL AREA IRRIGATED WITH UNTREATED SEWAGE WATER.
Chile Univ., Santiago. Dept. of Inorganic and Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W79-05643

FEASIBILITY STUDY FOR DEVELOPMENT OF A TRANSIENT THREE-DIMENSIONAL GROUNDWATER FLOW MODEL UTILIZING THE FINITE ELEMENT METHOD.
Maryland Univ., College Park. Water Resources Research Center.
Karl Wesley Seckel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 268. Price codes: A05 in paper copy, A01 in microfiche. Technical Report No. 51, 1978. 70 p, 7 fig, 54 ref. OWRT A-031-MD(2). 14-34-0001-7044.

Descriptors: Groundwater, Irrigation, Effluent disposal, *Groundwater flow, *Hydrologic models, *Porous media, Water table.

A transient three-dimensional groundwater flow model was developed from an already existing two-dimensional version. The finite element technique was used for the solution of the boundary value problem that governs flow in saturated-unsaturated porous media. Tetrahedral elements with linear interpolating polynomials were used in the

finite element development. A feasibility study for a three-dimensional groundwater flow model was needed to determine if the model could be used to study water table fluctuations on a spray irrigation site in St. Charles, MD. The model considers precipitation, evaporation, transpiration, and the application of spray effluent in evaluating the hydrologic response of the irrigation fields. To provide efficient and effective wastewater treatment, the model could facilitate the design, operation, and maintenance of the spray irrigation facility. The theoretical basis for developing a three-dimensional groundwater flow model using the finite element technique seems to be valid, but the solution of the mathematical model did not yield valid results. The error resulted, most likely, from an invalid formulation of the computer algorithm solution of the mathematical model. Attempts to locate the cause and origin of the error were unsuccessful but simulation results indicate that the error may occur in the elemental finite element formulation. For future investigations the selection and utilization of higher ordered elements other than the tetrahedral element should be more flexible and more efficient. The finite element method is a very complex and powerful technique and should only be approached by well qualified investigators.
W79-05799

AN ANALYSIS OF THE GROUNDWATER RESOURCES OF TONGATAPU ISLAND, KINGDOM OF TONGA.
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydrology, Vol 40, No 1/2, p 185-196, January 1979. 7 fig, 2 tab, 7 ref.

Descriptors: *Groundwater, *Water resources, *Water quality, *Saline water-freshwater interfaces, Islands, Piezometry, Water levels, Observation wells, Recharge, Natural recharge, Artificial recharge, Model studies, Mathematical models, Saline water intrusion, Chlorides, *Tongatapu Island(Tonga), *Tonga.

An analysis was made of the groundwater resources of Tongatapu Island. The Ghyben-Herzberg approximation was used to estimate thicknesses of a freshwater lens floating on seawater. Finite-difference calculations were used to estimate rainfall recharge rates, and calculations were made to investigate the dispersion of chloride ions across the freshwater-salt-water interface. These calculations suggest that artificial recharge might be a useful device to control chloride concentrations in the freshwater aquifer. (Sims-ISWS)
W79-05827

POSSIBLE MECHANISMS FOR LEAKAGE BETWEEN AQUIFERS AND RIVERS.
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and L. M. Tomlinson.
Journal of Hydrology, Vol. 40, No. 1/2, p 49-65, January 1979. 14 fig, 10 ref.

Descriptors: *Model studies, *Aquifers, *Leakage, *Rivers, Base flow, Darcys law, Flow, Groundwater movement, Water levels, Limestones, Transmissivity, Pumping, Storage coefficient, Groundwater recharge, Water wells, Equations, Mathematical studies, Linearity, Hydraulic head.

Leakage between aquifers and rivers was studied using an idealized, one-dimensional problem. Various leakage mechanisms were introduced, and the effects on heads in the aquifer and flows to the river were noted. Leakage was represented by a linear coefficient, a non-linear coefficient, and combination of the two. Leakage also was modelled directly as a known flow. It was shown that base-flow recessions are effectively independent of the magnitude of the linear leakage coefficient. (Visocky-ISWS)
W79-05851

THE FLOW MECHANISM IN THE CHALK BASED ON RADIO-ISOTOPE ANALYSES OF GROUNDWATER IN THE LONDON BASIN.
Department of the Environment, Reading (England). Central Water Planning Unit.
R. A. Downing, F. J. Pearson, and D. B. Smith.
Journal of Hydrology, Vol. 40, No. 1/2, p 67-83, January 1979. 3 fig, 3 tab, 24 ref.

Descriptors: *Carbon radioisotopes, *Groundwater, *Radioactive dating, *Aquifers, Porosity, Permeability, Tritium, Groundwater movement, Flow, Carbonate rocks, Chemical precipitation, Carbonates, Joints(Geologic), Fissures(Geologic), *England, *Chalk aquifer, *London Basin, Matrix, Double porosity.

14C analyses of groundwaters from the Chalk of the London Basin were re-interpreted, and the age of the groundwater was revised. Radioisotope analyses were used to examine the flow mechanism in the aquifer. The evidence supported the view that a network of microfissures and large intergranular pores in the matrix provides a significant part of the water pumped from Chalk wells and the major fissures distribute the water to the wells. Most of the matrix is fine-grained and contains a very old water. This diffuses into the microfissures and larger pores and is carried to the wells by the major fissures. (Visocky-ISWS)
W79-05852

EFFECT OF SEPTIC TANK EFFLUENT ON THE BASE STATUS OF TWO TILE-DRAINED SOILS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W79-05945

AVAILABILITY OF GROUND WATER IN THE LOWER MERRIMACK RIVER BASIN, SOUTHERN NEW HAMPSHIRE.
Geological Survey, Concord, NH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-05968

GROUND-WATER DATA FOR 1976-77 IN JOSHUA TREE NATIONAL MONUMENT, CALIFORNIA.
Geological Survey, Menlo Park, CA. Water Resources Div.
D. J. Downing.
Availability: OFSS, USGS Box 25425, Den. Fed. Ctr. Denver, CO. 80225. paper copy \$5.50, microfiche \$3.50. Geological Survey open-file report 78-854, October 1978. 34 p, 2 fig, 4 tab, 4 ref.

Descriptors: *Groundwater resources, *Well data, *Water levels, *Water yield, *Water quality, Aquifers, Observation wells, Chemical analysis, California, National parks, *Joshua Tree National Monument.

A continuing study of ground water in Joshua Tree National Monument, Calif., shows that during 1976-77 water levels fluctuated seasonally; slight declines were detected in the Oasis of Mara and the Pinto Basin. Water quality was generally good, with a high concentration of fluoride in one well in the southern part of the Monument. (Woodard-USGS)
W79-05982

POTENTIOMETRIC SURFACE OF FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT AND ADJACENT AREAS, SEPTEMBER 1978.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-05983

2G. Water In Soils

EQUILIBRIUM AND ACTUAL EVAPOTRANSPIRATION FROM A VERY DRY VEGETATED SURFACE

British Columbia Ministry of the Environment, Kamloops.

For primary bibliographic entry see Field 2D. W79-05529

CONCENTRATION AND SIZE OF GRAVEL IN RELATION TO NEUTRON MOISTURE AND DENSITY PROBE CALIBRATION

International Inst. of Tropical Agriculture Ibadan (Nigeria).

For primary bibliographic entry see Field 7B. W79-05530

COMPARISON OF 2.5- AND 21-CM MICRO-WAVE RADIOMETER OBSERVATIONS OVER SOILS WITH EMISSION MODEL CALCULATIONS

Regis Coll. Research Center, Weston, MA.

For primary bibliographic entry see Field 7B. W79-05533

NITROGEN AND CHLORIDE MOVEMENT IN SMALL UPLAND PIEDMONT WATERSHEDS: I. NITRATE-NITROGEN AND CHLORIDE DISTRIBUTION IN SOIL PROFILES

Southern Piedmont Conservation Research Center, Walkinsville, GA.

For primary bibliographic entry see Field 5B. W79-05541

CATION EXCHANGE EQUILIBRIA IN A MIXED SOIL SYSTEM CONTAINING THREE HETEROVALENT CATIONS

Texas Agricultural Experiment Station, Weslaco.

R. P. Wiedenfeld, and L. R. Hossner. Soil Science Society of America Journal, Vol. 42, No. 5, p 709-712, September-October, 1978. 4 fig, 1 tab, 12 ref.

Descriptors: *Cation exchange, Chemical reactions, Thermodynamic behavior, Calcium, Magnesium, Sodium, *Soil chemistry.

Cation exchange equations used with soils have been suitable only for systems containing two cations. Theoretical exchange equilibria relationships were presented for a mixed soil system containing three heterovalent cations: $\text{Ca}(2+)$, $\text{Mg}(2+)$, and $\text{Na}(+)$. Predictive equations for this tertiary system were derived using solid phase activity coefficients and thermodynamic equilibrium constants for the three binary systems obtained from experimental data. Theoretical cation exchange equilibria described for this tertiary system were in agreement with recognized exchange properties for these three cations. Interactions between two cations as they affect the exchange behavior of a third cation were also predicted. The methods presented are applicable to systems containing any number of heterovalent cations. (Skogerboe-Colorado State) W79-05588

ELECTRON PROBE MICROANALYTICAL STUDIES OF PHOSPHORUS DISTRIBUTION WITHIN SOIL FABRIC

West Pakistan Agricultural Univ., Lyallpur. Dept. of Soil Sciences.

R. H. Qureshi, D. A. Jenkins, and R. I. Davies. Soil Science Society of America Journal, Vol. 42, No. 5, p 698-703, September-October, 1978. 4 fig, 13 ref.

Descriptors: *Phosphorus, Chemical analysis, *Soil analysis, Soil tests, Analytical techniques, Root zone, Iron, Nutrients.

Electron probe microanalysis was used to follow the distribution of phosphorus and associated elements within soil features to establish the composition of the immediate root environment. Various

qualitative analytical modes of using the instrument were described involving either specimen traverse or spectrometer scanning with a static beam, line scanning, one-dimensional scanning, area scanning, or successive raster counting. By these means phosphorus was found to occur variously as discrete grains of rare-earth phosphates, in preferential association with iron in iron/manganese concretions, as concentrations within undifferentiated soil matrix and ferrans at void surfaces, and to be associated with calcium in a fresh root and possibly with iron rather than calcium, aluminum, or potassium in an old root. (Skogerboe-Colorado State) W79-05809

ELECTRON PROBE MICROANALYSIS OF CALCITE GRAINS CONTAINING PHOSPHORUS IN SOIL

West Pakistan Agricultural Univ., Lyallpur. Dept. of Soil Sciences.

R. H. Qureshi, and D. A. Jenkins.

Soil Science Society of America Journal, Vol. 41, No. 5, p 703-705, September-October, 1978. 4 fig, 11 ref.

Descriptors: *Calcite, *Phosphorus, Chemical analysis, Soil tests, Nutrients, *Soil analysis, Analytical techniques.

Calcite, comprising both clastic sand-sized grains and fossil foraminifera inherited from a marine Cretaceous (Gault) clay, was isolated from a haplaquept (gleyic brown calcareous earth) in the United Kingdom and shown by wet chemical analysis to contain an average of 0.3% phosphorus. Electron probe microanalysis indicated that this phosphorus is uniformly distributed within the calcite rather than concentrated as discrete calcium phosphates, and it was concluded that it was biogenic/diagenetic rather than pedogenic in origin. Such sources were found to constitute 50-80% of the total soil phosphorus and thus suggested to be relatively available in the upper horizons of the profile. (Skogerboe-Colorado State) W79-05810

DIELECTRIC CONSTANTS OF SOILS AT MICROWAVE FREQUENCIES-II

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.

J. Wang, T. Schmugge, and D. Williams. NASA Technical Paper 1238, May 1978. 32 p, 19 fig, 2 tab, 18 ref.

Descriptors: *Soils, *Microwaves, *Soil moisture, Soil types, Measurement, Frequency, Soil texture, Moisture, Mathematical studies, Sampling, Soil analysis, Slopes, Methodology, Soil water, Groundwater, Moisture content, Algorithms, Mathematics, Laboratory tests, Data collections, Soil dielectric constants.

The dielectric constants of several soil samples were measured at frequencies of 5 and 19 GHz using the infinite transmission line method. The results of these measurements were presented and discussed with respect to soil types and texture structures. A comparison was made with other measurements at 1.4 GHz. At all three frequencies, the dependence of dielectric constant on soil moisture can be approximated by two straight lines. At low moisture, the slope is less than at high moisture level. The intersection of the two lines is believed to be a function of soil texture. (Froelich-ISWS) W79-05861

2H. Lakes

MAJOR CHEMICAL CONSTITUENTS OF ARIZONA LAKES

Arizona Univ., Tucson.

E. A. Stull, and S. J. Kessler.

Journal of the Arizona-Nevada Academy of Science, Vol. 13, No. 2, p 57-61, June 1978. 3 fig, 2 tab, 10 ref.

Descriptors: *Chemical analysis, *Chemical properties, *Arizona, *Lakes, *Lake morphology, Quantitative analysis, Sampling, Biochemistry, Microbiology, Lake basins, Chemical composition, Physical properties, Specific conductivity, Calcium, Magnesium, Alkalinity, Sulfates, Chlorides, Potassium, Silica, Watersheds (Basins).

Information on the major chemical constituents of Arizona lakes is important to the proper evaluation and understanding of these valuable water resources. The purpose of the present study was to determine and compare the major chemical constituents of 23 Arizona reservoirs selected to represent the diversity of Arizona waters and to suggest a correlation between these chemical compositions and the geographic patterns of Arizona's arid environment. Physical and chemical parameters of the 23 chosen reservoirs were surveyed twice during two fifteen-day periods in May-June and July, 1976. Specific conductance, calcium, magnesium, sodium, total alkalinity, sulfate, chloride, potassium and silica concentrations were determined in the laboratory 6 to 8 months after collection on unfiltered samples. Although results indicated the lakes to be chemically diverse, geographic trends in chemical concentration were clearly evident. The general pattern found was dilute lakes in the moist highlands and weakly saline lakes in the drier lowlands. It is concluded that a high proportion of the variance in the chemical composition of Arizona lakes can be described by variables of climate and watershed morphology. (Tickee-Arizona) W79-05567

EARTH DAMS AND RESERVOIRS

Soil Conservation Service, Washington, DC. Engineering Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-260 770, Price codes: A04 in paper copy, A01 in microfiche. Technical Release No. 60, June 1976. 50 p, 8 fig, 9 tab.

Descriptors: *Earth dams, *Embankments, *Reservoirs, *Hazards, *Sedimentation, Design criteria, Spillway, Seismic design, Geologic investigations, Hydraulic structures, Flood control, *Hazard classes, Seismic assessments, Emergency spillways.

The publication described design procedures and minimum requirements for planning and designing earth dams and associated spillways. The dams and reservoirs considered are larger than ordinary farm ponds. Dams were classified in 3 categories considering the hazard potential to property, communication lines, and human lives. Hydrology requirements and data were presented for each of the 3 hazard classes. Geologic investigation requirements were covered including seismic assessments. Earth embankments and foundations were described, including minimum factors of safety for embankment slope stability. Principal and emergency spillways, together with their hydraulic and structural design, also were included. (Singh-ISWS) W79-05612

LAKE ERIE ICE: WINTER 1975-76

National Oceanic and Atmospheric Administration, Rockville, MD. Environmental Science Information Center.

For primary bibliographic entry see Field 2C. W79-05615

SNOW AND ICE IN THE PHOSPHORUS BUDGET OF A LAKE IN SOUTH CENTRAL ONTARIO

Trent Univ., Peterborough (Ontario).

For primary bibliographic entry see Field 2C. W79-05620

INERTIAL CURRENTS IN LAKE ONTARIO, WINTER 1972-73 (IFYGL)

Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.

G. O. Marmorino.

Journal of Physical Oceanography, Vol. 8, No. 6,

Field 2—WATER CYCLE

Group 2H—Lakes

p 1104-1120, November 1978. 16 fig. 3 tab, 38 ref.

Descriptors: *Lake Ontario, *Great Lakes, *Currents(Water), Limnology, Stratification, Lakes, Hydrology, Winter, Frequency, Waves(Water), Ice, Ice cover, *Inertia currents(Water), Inertia oscillations, Hodographs, Internal-inertia waves, Vertical stratification, Oscillations.

Nearly 4 months of continuous current and temperature data, taken during the 1972-73 winter at depths of about 15 and 75 m in Lake Ontario, were analyzed for evidence of inertial oscillations. The data, collected as part of the International Field Year for the Great Lakes (IFYGL), were obtained at 9 stations: one near midlake, about 40 km from shore, and in about 140 m of water; the other 8 spaced around the lake, about 50 km apart, 12 km from shore and in 100 m of water. Inertial currents occurred in episodes lasting less than 5 days and had speeds less than 15 cm per second. At the midlake and easternmost stations, the inertial currents accounted for as much as 10% (on average) of the total current variance. Some inertial events in midlake had no counterpart nearer shore. In contrast, a lakewide episode of inertial currents was induced by a storm during a two to three week period of vertical stratification. The average hodographs during the stratified period, calculated from band-passed shallow currents, were ellipses with major axes oriented generally alongshore and axis ratios of 1.05 to 1.64. Some of the data can be interpreted in terms of internal-inertia waves with downward energy propagation and a vertical wavelength equal to the basin depth. Observed shifts to frequencies higher and lower than the inertial value were most likely caused by an interaction with lower frequency currents (Doppler effects). (Lee-ISWS)

W79-05634

A THREE-DIMENSIONAL MODEL OF LAKE ONTARIO'S SUMMER CIRCULATION, II. A DIAGNOSTIC STUDY.

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. R. Bennett.

Journal of Physical Oceanography, Vol. 8, No. 6 p 1095-1103, November 1978. 6 fig, 11 ref. NOAA 03-5-002-57.

Descriptors: *Lake Ontario, *Great Lakes, *Model studies, Circulation, Numerical analysis, Currents(Water), Limnology, Hydrology, Summer, Lakes, Winds, Air circulation, *Two-layer circulation models, Lake circulation, Cyclonic circulation, Wind-driven current.

A two-layer circular lake model was used to study the mean flow of Lake Ontario during midsummer. By computing the model only to the second order of amplitude, it was shown that the observed cyclonic circulation of Lake Ontario during summer is due to the rectified effects of the large, transient, wind-driven currents. This effect is strongly influenced by model grid resolution and friction. (Lee-ISWS)

W79-05635

MIGRATING THERMAL STRUCTURE IN A FRESHWATER THERMOCLINE, Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).

J. Lazier, and H. Sandstrom.
Journal of Physical Oceanography, Vol. 8, No. 6, p 1070-1079, November 1978. 5 fig, 1 tab, 13 ref.

Descriptors: *Lakes, *Canada, *Water temperature, *Model studies, *On-site investigations, Thermocline, Mathematical models, Freshwater, Temperature, Winds, Stratification, Theoretical analysis, On-site data collections, Depth, Profiles, Limnology, *Lake William(Nova Scotia).

The vertical migration of thermal structure in freshwater thermoclines was investigated with theory and observations. The theory was for the wind-forced internal oscillations of a viscous, non-

rotating, long, narrow, lake of constant stratification. The introduction of viscosity resulted in a smooth phase change with depth near the nodes of the vertical displacement profiles. The gradual change of phase enabled the theory to model the observed vertical migration of the temperature structure created by the internal oscillations. The theory was compared to data obtained from a vertical array of thermistors moored in a stratified freshwater lake. Vertical phase profiles calculated from the thermistor chain data agreed well with the theoretical profiles for values of kinematic viscosity of about 0.000001 sq m/s. The amplitudes of the vertical displacement away from the nodes agreed reasonably well with values predicted by the theory. The agreement was sufficient to warrant the description of the migrating structures in terms of damped internal oscillations of the lake. (Sims-ISWS)

W79-05636

HYDROGEOLOGY AND COMPUTER MODEL OF THE BASS LAKE AREA, ST. CROIX COUNTY, WISCONSIN,

Department of Geology and Geophysics, University of Wisconsin-Madison.

M. B. Rinaldo-Lee, M. P. Anderson, D. A. Stephenson, and S. F. Huffman.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 457. Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center, University of Wisconsin, Technical Report WIS WRC 79-01, 1979. 48 p, 24 fig, 4 tab, 15 ref. OWRT A-075-WIS(1). 14-34-0001-7106, 14-34-0001-8053.

Descriptors: *Lakes, Dams, Hydrogeology, Groundwater, Flow, *Hydrologic model, Water levels, Bass Lake, Mounds Pond, Wisconsin.

Bass Lake is one of several lakes in northern Wisconsin where high water levels in the early 1970's caused flooding of homes. Because Bass Lake is a groundwater dominant lake with no inlet or outlet, it was speculated that high water levels were caused by increased groundwater discharge to the lake brought about by an impoundment, Mounds Pond, located 1.5 miles to the south and 12 feet higher than the normal elevation of Bass Lake. In order to determine probable cause of the high lake levels, an investigation into the hydrogeology of the area was initiated in the field. In addition to field data collection, a computer model was used to simulate the effects on the lake elevation of changing various parameters. Bass Lake appears to be influenced by both a regional flow-through and a local recharge system in the southern part of the lake and by a regional flow-through system in the northern part of the lake. Results of the field study indicate that there is no groundwater flow between Mounds Pond and Bass Lake. Computer model simulations indicated that lowering Mounds Pond by 10 feet, as was suggested as a means of alleviating the flooding at Bass Lake, would have no effect on Bass Lake levels. Results from computer model simulations designed to simulate the effects of an increase in recharge rate indicate that an increase in precipitation caused the abnormally high lake levels observed during the early 1970's. This conclusion was supported by an analysis of climatological data. Changes in lake level which coincide with changes in precipitation should be expected to occur in groundwater dominant lakes and allowances for fluctuations must be made when planning shoreline developments.

W79-05795

PREDICTING NIGHTTIME OXYGEN DEPLETION IN CATFISH PONDS,

Auburn Univ., AL. Water Resources Research Inst.

R. P. Romaine, and C. E. Boyd.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 266. Price codes: A03 in paper copy, A01 in microfiche. Agricultural Experiment Station Bulletin 505, September, 1978, 32 p. OWRT A-066-ALA(2).

Descriptors: *Dissolved oxygen, *Catfish, Aeration, Ponds.

Inadequate concentration of dissolved oxygen (DO) has long been recognized as a critical factor in the intensive production of channel catfish (*Ictalurus punctatus*) in ponds. Emergency aeration should be initiated in ponds when the DO concentration declines to less than 2.0 parts per million (ppm). Presently, fish culturists have no reliable technique for predicting if DO will fall below this critical level during the night. Emergency aeration is frequently used when not required, and in some cases, it is not used when needed. The data herein provide the culturist with two practical methods for predicting at dusk (or shortly thereafter) if DO depletion is likely to occur in a pond during any given night, thereby allowing time to prepare for emergency aeration.

W79-05800

LONGSHORE TRANSPORT AT A TOTAL LITTORAL BARRIER,

Coastal Engineering Research Center, Fort Belvoir, VA.

R. O. Bruno, and C. G. Gable.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A042 473. Price codes: A02 in paper copy, A01 in microfiche. Reprint 77-6, July 1977. 19 p, 10 fig, 2 tab, 7 ref.

Descriptors: *Currents(Water), *Beaches, *Littoral drift, *California, *Beach erosion, *Sediment transport, Waves(Water), Harbors, Breakwaters, Analysis, Hydrography, On-site investigations, Coastal processes, Longshore currents.

Analysis of longshore transport at a littoral barrier was presented. Channel Islands Harbor, California, was selected as the study site because its offshore breakwater and jetties form a unique complete littoral barrier. Through repetitive surveys, an accurate determination of longshore material transport in one direction was made. Measured transport rates ranged from 160,000 to 1,284,000 cubic meters per year. Utilizing visual observations of surf parameters, estimates of longshore wave thrust were computed. The range of wave thrust was 145 to 1,988 newtons per meter. Comparison of the relation of wave thrust and longshore sediment transport was made. This study indicated that in an environment of high transport, nearly twice as much transport is predicted under corresponding wave thrust as that of the data summarized in the Coastal Engineering Research Center's Shore Protection Manual. (Adams-ISWS)

W79-05838

APPLICATION OF RIDGE REGRESSION ANALYSIS TO WATER RESOURCES STUDIES,

Agricultural Research and Education Center, Belle Glade.

For primary bibliographic entry see Field 2A. W79-05853

ASSESSMENT OF A COOLING LAKE ECOSYSTEM,

Wisconsin Univ.-Madison. Lab. of Limnology. S. J. Lozano, D. W. Rondorf, and J. F. Kitchell.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 537. Price codes: A06 in paper copy, A01 in microfiche. Water Resources Center, University of Wisconsin, Technical Report, 1978. 109 p, 49 fig, 12 tab, 107 ref. OWRT A-070-WIS(3). 14-34-0001-6052, 14-34-0001-7105, 14-34-0001-7106.

Descriptors: *Water cooling, Limnology, Biological communities, Primary production, *Lakes, Phytoplankton, Aquatic life, Lake Columbia, Wisconsin.

Primary production, aquatic invertebrates, and fish were studied during 1975-1977 to determine responses of organisms to a 15°C temperature gradient in a 190-hectare diked cooling lake, Lake Columbia, WI. The relative importance of macrophytes, periphyton, and phytoplankton production to primary production of the cooling lake is discussed. Seasonal and spatial changes in species composition of periphyton are shown. Field and

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laboratory studies of invertebrate distribution, growth, and reproduction show evidence that modified life history and temperature directed movement are two important mechanisms by which invertebrates change their distribution in a heterothermal environment. Distribution of *Hyalina azteca*, a stenothermal amphipod, and reproductive responses of two eurythermal ostracods, the parthenogenetic *Cypripoda vidua* and the syngamic *Physocypris pustulosa*, were studied. Species diversity, distribution, growth, and reproductive responses of fish in a newly impounded cooling lake are described. Simple models are used to describe relative abundance and aggregation of fish relative to water temperature during a summer and winter. The importance of temperature changes, caused by spring power plant shutdowns, to the temporal placement of spawning, duration of spawning, and apparent reproductive success as determined by sampling adult and larval fish is shown for black crappie, *Pomoxis nigromaculatus*, and white bass, *Morone chrysops*. From these studies site specific and general management strategies were formulated.

W79-05964

2I. Water In Plants

SALT TOLERANCE IN THE WILD RELATIVES OF THE CULTIVATED TOMATO: RESPONSES OF *SOLANUM PENNELLII* TO HIGH SALINITY.

Ben-Gurion Univ. of the Negev, BeerSheva (Israel). Dept. of Biology.
K. Dehan, and M. Tal.
Irrigation Science, Vol. 1, No. 1, p 71-76, August, 1978. 5 tab, 12 ref.

Descriptors: *Salt tolerance, Salinity, *Tomatoes, Moisture deficit, Ions.

The cultivated tomato *Lycopersicon esculentum*, cultivar Rheinlands Ruhm, and the wild species *Solanum pennellii* accession Atico, were compared with respect to their salt tolerance. The wild species was more salt tolerant than the cultivated tomato. In contrast to *L. esculentum* plants, the growth of the wild species was not impaired by the high salinity, although the latter accumulated more Cl^- and Na^+ ions and its K^+ level decreased under salinity. The smaller increase in water deficit under salinity in the wild species was attributed to its higher accumulation of ions. (Skogerboe-Colorado State)
W79-05813

THE EFFECT OF SUPPLEMENTAL IRRIGATION AND NITROGEN FERTILIZATION ON WHEAT (*TRITICUM AESTIVUM* L.).

Agricultural Research Organization, Gilat (Israel). Regional Experiment Station.
D. Shimshi, and U. Kafkafi.
Irrigation Science, Vol. 1, No. 1, p 27-38, August, 1978. 2 fig, 7 tab, 13 ref.

Descriptors: *Irrigation effects, Fertilization, Nitrogen, *Wheat, Crop response, Crop production, Growth stages.

During 1971-72 an experiment was conducted at the Gilat Regional Experiment Station in the Negev region of Israel, in which the combined effect of irrigation and nitrogen fertilizer on wheat was studied. The following aspects were investigated: the general nature of the interaction of irrigation and nitrogen on crop yields and the effect of nitrogen on water use and water relations of the wheat plant. (Skogerboe-Colorado State)
W79-05817

WATER RELATIONS OF CADMIUM-TREATED PLANTS.

Oklahoma State Univ., Stillwater. Dept. of Agronomy.
M. B. Kirkham.
Journal of Environmental Quality, Vol. 7, No. 3, p 334-336, July-September, 1978. 2 fig, 1 tab, 21 ref.

Descriptors: *Turgidity, Water pressure, Osmotic pressure, *Cadmium, *Transpiration, Soil-plant relationships.

Turgor pressures, stomatal resistances, and transpiration rates were measured during a 50-day period in leaves of chrysanthemum (*Chrysanthemum morifolium* Ramat. 'Indianapolis White') plants grown in nutrient solution with 0, 0.01, 0.1, and 0.0 microgram/ml Cd added as $CdSO_4$. At harvest, dry weight and Cd concentrations in roots, stems, and leaves were determined. Leaf abscission occurred on Cd-treated plants. Turgor pressures were highest in plants grown with 0.01 microgram/ml Cd and lower in plants treated with 0, 0.1, and 1.0 microgram/ml Cd. Stomatal resistances were lowest in plants grown with 0.01 microgram/ml Cd and progressively higher in plants treated with 0, 0.1, and 1.0 microgram/ml Cd. Results indicated that quantities of Cd permitted in irrigation water in the United States (0.05 microgram/ml) might be detrimental to growth because of reduced turgor pressure and increased stomatal resistance. (Skogerboe-Colorado State)
W79-05934

GROWTH AND ELEMENTAL COMPOSITION OF CORN AND BEAN SEEDLINGS AS INFLUENCED BY SOIL APPLICATION OF COAL ASH.

Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5B.
W79-05942

THE UPTAKE OF ^{203}Hg -LABELED MERCURY COMPOUNDS BY BROMEGRASS FROM IRRIGATED UNDISTURBED SOIL COLUMNS.

Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W79-05943

2J. Erosion and Sedimentation

PREDICTING SAND DEPOSITION AT POROUS FENCES.

B. P. Petroleum Development Ltd., Aberdeen (Scotland).
C. J. Phillips, and B. B. Willets.
Journal of the Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers, Vol. 105, No. WW1, Proceedings Paper 14379, p 15-31, February 1979. 15 fig, 1 tab, 13 ref, 2 append.

Descriptors: *Dune sands, *Wind erosion, *Erosion control, *Model studies, Laboratory tests, Mathematical models, Sands, Dunes, Erosion, Sedimentation, Sediment transport, Winds, Coasts, Beaches, Stabilization, Coastal engineering, Sand fences.

For porous fences of limited height and 'infinite' length, measurements of boundary shear stress were reported in air flow normal to the fence plane. On the assumption that boundary shear stress is similarly distributed in sand-laden flow, calculations were made of the growth of a dune near a fence placed normal to the transport direction of sand. Although based on formulas developed for circumstances of uniform flow and transport rate, the calculations were reasonably successful when compared with small-scale wind-tunnel experiments. It was shown that the effect of jetting through fence gaps should be allowed for in calculations and that this can be done quite simply, and also that each sand (and by implication each sand condition) requires its own transport rate formula. Grain collisions with fence members and the effect of probable miscalculation of characteristic path length were examined but not resolved. (Sims-ISWS)
W79-05533

STATISTICAL ANALYSIS OF CONCENTRATION RECORDS.

Science and Education Administration, Oxford, MS. Sedimentation Lab.
J. C. Willis, and G. C. Bolton.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY1, Proceedings Paper 14310, p 1-15, January 1979. 13 fig, 1 tab, 10 ref, 2 append.

Descriptors: *Bed load, *Sediments, *Statistical methods, Analytical techniques, Data processing, Laboratory tests, Flumes, Sands, Sediment transport, Statistics, Turbulence, Suspended solids, Hydraulics, *Sediment concentration, Statistical analysis.

A time-series analysis of continuous records of total discharge concentration of bed material from tests in a laboratory flume defined experimental values of the mean statistical parameters (mean concentration, standard deviation of the concentration fluctuations, and mean spectral frequency) as well as the probability and spectral distribution functions. The mean concentration and standard deviation were closely related only to the Froude number of the flow, but the mean spectral frequency and the normalized spectra and probability functions exhibited additional variability that may be attributed to a combined influence of water temperature and flow variables. That the mean concentration was only about 1.6 times the standard deviation illustrated the extreme variability of concentration data. (Sims-ISWS)
W79-05535

EFFECTS OF HINDERED SETTLING ON SEDIMENT CONCENTRATION PROFILES.

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.

J. W. Lavelle, and W. C. Thacker.
Journal of Hydraulic Research, Vol. 16, No. 4, p 347-355, 1978. 4 fig, 1 tab, 13 ref.

Descriptors: *Sediments, *Suspended solids, *Settling velocity, *Model studies, Mathematical models, Laboratory tests, Flumes, Bed load, Bottom sediments, Turbulence, Diffusivity, Mixing, Sedimentology, *Sediment concentration.

Suspended sediment distributions which take into account concentration-dependent settling velocities were derived. The distributions were compared with the high concentration data of Einstein and Chien and were found to be in good agreement. The analysis showed that concentrations at the sediment bed in the Einstein-Chien data were close to those of saturated sediments, which leads to the suggestion that the reference level in the distributions always should be taken at the bed where the reference concentration is flow independent. A suspended sediment distribution constructed in this way guarantees a reasonable value for concentration near the bed and depends on two diffusivity parameters which the Einstein-Chien concentration data indicate are related. (Sims-ISWS)
W79-05542

ARID GEOMORPHOLOGY.

Oxford Univ. (England).
A. Goudie.
Progress in Physical Geography, Vol. 2, No. 2, p 333-338, 1978. 44 ref.

Descriptors: *Geomorphology, *Land forms, *Earth-water interfaces, Fluvial sediments, Erosion, Geophysics, Arid lands, Solar radiation, Aeolian soils.

Concepts relating to development of desert landscapes by wind erosion, water action, and mechanical weathering have undergone much debate over the last two decades. The generally accepted view during the 19th century that desert landforms were produced largely by mechanical weathering and wind action, was largely replaced during the 20th century by laboratory simulation studies indicating the predominant force in desert creation to be water action. Although insolation weathering and wind erosion are perhaps not the principal

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forces, further developments have again occurred in the 1970s to indicate that both deserve more respectful attention in considering the general concept of arid geomorphology. The author urges geomorphologists to disregard wind and water as opposites and consider more seriously the contribution eolian materials make to fluvial sedimentation and conversely, that fluvial materials made to eolian deflation. (Tickes-Arizona)
W79-05558

DUST STORMS AND THEIR GEOMORPHOLOGICAL IMPLICATIONS, Oxford Univ. (England). School of Geography. A. S. Goudie.

Journal of Arid Environments, Vol. 1, No. 4, p 291-310, December 1978. 6 fig, 10 tab, 143 ref.

Descriptors: *Dust storms, *Wind erosion, *Erosion rates, *Sediment transport, *Geomorphology, *Environmental effects, *Fluvial sediments, Aeolian soils, Eluvium, Loess, Soil erosion, Particle size, Soil stabilization, Sediment load, Glacial sediments, Soil formation, Water quality, Moisture deficit, Frequency analysis, Precipitation (Atmospheric), Meteorology, Climatology, Groundwater, Depression.

Dust storms, common phenomena in many parts of the world, are especially apparent in arid regions where they represent the result of a substantial degree of deflation and erosion. The numerous environmental consequences of these storms include their effects on climatic change, ocean sedimentation, soil formation, groundwater quality, crop growth, and glacier ice quality. The purpose of this study was to analyze the frequency of dust storms, their distribution, rate of deposition, amount of erosion, and the nature of the materials laid down by them with particular attention to occurrences in arid regions of the Middle East, India, China, and the U.S.S.R. Although the role of wind as a geomorphic agent has frequently been minimized, it is suggested here that dust storms in arid regions occur with considerable frequency and areal extent. Principal factors appearing to control dust storm generation are quantity of precipitation, which largely effects the degree of vegetative cover and soil moisture characteristics, wind velocity, and source of material. Dust deposition rates are substantial not only at desert margins but also at greater distances into the non-arid regions where data suggest that rates of aeolian accumulation may be as high as fluvial erosion rates. Data for both individual and generalized storms are presented and results of chemical and grain size analysis reviewed. (Tickes-Arizona)
W79-05559

GRANULAR MEDIA FILTRATION OF DREDGING EFFLUENTS

Northwestern Univ. Evanston, IL. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5A.
W79-05621

PHYSICAL OCEANOGRAPHY OF THE MIDDLE ATLANTIC BIGHT

Woods Hole Oceanographic Institution, MA.; Johns Hopkins Univ., Baltimore, MD. Chesapeake Bay Inst.; and National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.

R. C. Beardsley, W. C. Boicourt, and D. V. Hansen.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.). American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 20-34, 1976. 4 fig, 3 tab, 39 ref. Allen Press, Inc., Lawrence, Kansas.

Descriptors: *Baseline studies, *Oceanography, *Ocean circulation, Water quality, Sediment transport, Water pollution, *Outer Continental Shelf, *New York Bight.

Kinetic energy spectra from moored current meters in the mid-Atlantic Bight reveal marked differences in current variability between the inner shelf and the outer shelf and slope regions. The nearshore subtidal current variability appears to be dominated by meteorological forcing. The amplitude of the semidiurnal and diurnal tidal peaks decreases in the offshore direction. Shallow water records show little or no inertial energy, while at the shelf break and over the slope, inertial motion contributes significantly to the current variance. A simple conceptual model is presented to explain how intense winter low pressure systems ('northeasters') drive strong alongshore currents which are coherent over much of the bight. A map of 'mean' currents measured in recent moored array experiments demonstrates subsurface water flow along the shore toward the southwest. The average currents generally increase in magnitude offshore and decrease with closeness to bottom. At most sites, the mean current veers toward shore with increasing depth. The alongshore volume transport measured at three transects across the bight shows surprising uniformity, considering the possible sources for discrepancy. This transport of water within the 100-m isobath implies a mean residence time of the order 3/4 year. Much of the shelf water observed flowing westward south of New England must originate in the Gulf of Maine-Georges Bank area. (Sinha-OEIS)
W79-05680

NEW YORK BIGHT WATER STRATIFICATION—OCTOBER 1974

Lamont-Doherty Geological Observatory, Palisades, NY.

For primary bibliographic entry see Field 1A.
W79-05682

MORPHOLOGIC EVOLUTION AND COASTAL SAND TRANSPORT, NEW YORK-NEW JERSEY SHELF

National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.

D. J. P. Swift, G. L. Freeland, P. E. Gadd, G. Han, and J. W. Lavelle.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.). American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 69-89, 1976. 19 fig, 36 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Baseline studies, *Sediment transport, *Sedimentation, Erosion, Environmental effects, Geomorphology, *Outer Continental Shelf, *New York Bight, Nearshore processes, Estuarine processes, Coastal morphology.

The surface of the New York-New Jersey shelf has been extensively modified by landward passage of nearshore sedimentary environments during the postglacial rise of sea level. The retreat of estuary mouths across the shelf surface has resulted in shelf valley complexes. Constituent elements include shelf valleys largely molded by estuary mouth scour, shoal retreat massifs left by the retreat of estuary mouth shoals, and midshelf or shelf-edge deltas. The erosional retreat of the straight coast between estuary mouths has left a discontinuous sheet of clean sand 0-10 cm thick. During the retreat process, a sequence of oblique-trending, shoreface-connected sand ridges formed at the foot of the shoreface. As a consequence, the surficial sand sheet of the shelf floor bears a ridge and swale topography of sand ridges up to 10 m high and 2-4 m apart. The mechanics of sedimentation in these two nearshore environments (estuary mouth and interestuarine coast) are now being investigated for purposes of environmental management as well as for further understanding of shelf history. Systematic observations of sedimentation in New York Harbor mouth have not yet been initiated. However, reconnaissance data reveal a complex pattern of ebb- and flood-dominated zones that control the pattern of sand storage. (Sinha-OEIS)
W79-05684

SUSPENDED PARTICULATE CONCENTRATIONS AND COMPOSITIONS IN THE NEW YORK BIGHT

Lamont-Doherty Geological Observatory, Palisades, NY.

For primary bibliographic entry see Field 5C.
W79-05687

DEVELOPMENTAL TESTS ON THE USE OF FLUORESCENT TRACERS AND BACKWASH SEDIMENT-LOAD SAMPLERS TO MEASURE THE BEACH DRIFT COMPONENT OF LITTORAL TRANSPORT AT SANDY HOOK, NEW JERSEY

Teachers Coll., New York. Dept. of Science Education. W. E. Yasso.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.). American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 138-149, 1976. 6 fig, 3 tab, 7 ref. Allen Press Inc., Lawrence, Kansas. ONR-NR-388-057.

Descriptors: *Baseline studies, *Sediment transport, *Littoral drift, *Erosion, Sedimentation, Beach erosion, Environmental effects, Water resources, *Outer Continental Shelf, *New York Bight.

Simple, flat-bottomed, troughlike devices made of sheet metal were used to sample bedload and suspended load of individual backwashes in time-integrated studies of beach drift rate on the shore at Sandy Hook, New Jersey. In the most complete experiment first arrival of fluorescent tracer particles, in the medium to coarse sand range, showed a negative linear relationship between particle diameter and beach drift velocity. Peak-of-distribution arrivals, based on smoothed recovery distributions obtained by weight ratio conversion procedures, confirm the inverse sediment size-beach drift velocity relationship. Increase in mean backwash sediment mass is roughly correlated with increase in the product of breaker height squared and breaker period squared. However, both this relationship and the anomalous variability and apparent periodicity in sediment mass entrained by individual backwashes will require further investigation. (Sinha-OEIS)
W79-05688

FREQUENCY AND EXTENT OF WIND-INDUCED RESUSPENSION OF BOTTOM MATERIAL IN THE U.S. GREAT LAKES NEARSHORE WATERS

Wisconsin Univ., Madison. Water Resources Center.

V. P. Kozak, and G. V. Simsiman. International Joint Commission, International Reference Group on Great Lakes Pollution from Land Use Activities, Technical Report for U.S. Task Force D, June 1978. 111 p, 34 fig, 26 tab, 74 ref, 7 append. EPA 68-01-1598.

Descriptors: *Reviews, *Winds, *Resuspension, *Bottom sediments, *Great Lakes, *Nearshore zones, *Water pollution sources, *Path of pollutants, *Sedimentation, Sediments, Lakes, Lake Erie, Lake Michigan, Lake Huron, Lake Ontario, Lake Superior, Waves, Soil erosion, Land use, Research priorities, International Joint Commission.

An extensive literature review was conducted to determine the frequency and extent of wind-induced resuspension of bottom sediments in the U.S. Great Lakes nearshore zones, and to identify nearshore areas where sediment characteristics and wind/wave conditions are especially conducive to seasonally periodic bottom sediment resuspension. Wind and wave characteristics and properties of nearshore surficial sediments were two major areas explored, and limited information on critical velocities and entrainment was evaluated. The magnitude of sediment resuspension was closely related to frequency (days/yr) of occurrence of strong wind-generated waves. Sediment type also had a strong influence on resuspension, as demonstrated in Lake Erie's western basin, dominated by fine

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sediments, where larger amounts of sediments are resuspended than in central and eastern areas, despite the greater probability of resuspension in the latter areas based on hydrodynamic considerations. Predicted sediment resuspension quantities from this study were about as great as indicated by data from limited field observations. Ranking of near-shore areas by quantity of resuspended sediment correlates well with ranking obtained by resuspension frequency for lakes Michigan and Ontario. High sediment resuspension potential was found for nearshore areas of eastern Lake Ontario, eastern and southern Lake Michigan, Saginaw Bay and St. Clair River areas of Lake Huron, and east- and west-central Lake Superior. Additional research needs are identified. (Lynch-Wisconsin) W79-05736

SUBSURFACE DRAINAGE MODEL WITH ASSOCIATED SEDIMENT TRANSPORT, Florida Univ., Gainesville. A. B. Bottcher, E. J. Monke, and L. F. Huggins. Paper No. 78-2502, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois, 21 p. 4 fig, 15 ref, ASAE, St. Joseph, Michigan.

Descriptors: *Subsurface drainage, *Model studies, Computer models, Sediment transport, Simulation analysis, Tile drainage, Sediment yield, Flow rates.

A computer model was developed, using the GASP IV simulation language to simulate the water flow and sediment movement from a subsurface drainage system. The model uses a one dimensional form of the Richard's Equation and a steady state tile flow formula by Tosko and Kirkham to express the water movement process. The particle detachment model, which is based on a force balance relationship, is driven directly by the output of the flow model. Data required by the model includes rainfall, evapotranspiration, soil properties, and the drainage system layout. Calibration and verification was completed using data collected from a seventeen hectare tile drainage system located on a flat Hoytville silty clay soil. A comparison of the simulated and observed results indicate that the model will reliably predict water yield, sediment yield and the sediment concentration curve. The model had difficulty in simulating the actual shape of the flow hydrograph. (Skogerboe-Colorado State) W79-05802

EROSION CONTROL/SEDIMENT MODELING—SOUTHERN IDAHO A PROGRESS REPORT, Idaho Agricultural Experiment Station, Aberdeen. T. S. Longley.

Paper No. 78-2028, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 6 p. 3 fig, 4 ref, ASAE, St. Joseph, Michigan.

Descriptors: *Soil erosion, Agricultural watersheds, *Sediment load, Return flow, Idaho, Irrigation, Model studies.

The progress of erosion control/sediment modeling was reported. The modeling effort proceeded in three steps: (1) the furrow erosion submodel, (2) the instream erosion control practice submodel, and (3) the routing model to route the water down through the watershed. The furrow erosion submodel predicts the sediment lost from an individual field using furrow hydraulic parameters and the stream power concept. The instream erosion control practice submodel predicts the effectiveness of the best management practices in cleaning the sediment from the return flow, and finally a routing procedure is used to move the flow and associated sediment through the watershed. (Skogerboe-Colorado State) W79-05804

LONGSHORE TRANSPORT AT A TOTAL LITTORAL BARRIER, Coastal Engineering Research Center, Fort Bel-

voir, VA.

For primary bibliographic entry see Field 2H. W79-05838

THE SUSPENDED SEDIMENT REGIME OF AN OREGON COAST RANGE STREAM, Pacific Northwest Forest and Range Experiment Station, College, AK, Alaska Region. S. J. Paustian, and R. L. Beschta. Water Resources Bulletin, Vol. 15, No. 1, p 144-154, February 1979. 4 fig, 1 tab, 21 ref.

Descriptors: *Oregon, *Suspended solids, *Streams, Sediment transport, Streamflow, Storms, Winter, Forest watersheds, Hydrology, Runoff, Streambeds, Mountains, Seasonal, Discharge (Water), Suspended load, *Mountain streams, Sediment-discharge relationship, Storm-generated runoff.

Armored stream segments may affect the suspended sediment regime of small mountain streams in western Oregon by the release of fine sediments stored in the bed gravels. Sieve analysis of bed materials indicated that at least 30% of the suspended sediment yield for the 1975-76 winter had been stored in the streambed. Suspended sediment concentrations during storm-generated runoff were influenced by stream discharge and hydrograph characteristics. Sediment-discharge relations for individual storms were characterized by hysteresis loops. A seasonal flushing of fines was shown by a progressive decrease in the ratio of suspended sediment to stream discharge during the winter runoff period. (Lee-ISWS) W79-05846

QUANTITATIVE ANALYSIS OF AIRCRAFT MULTISPECTRAL-SCANNER DATA AND MAPPING OF WATER-QUALITY PARAMETERS IN THE JAMES RIVER IN VIRGINIA, National Aeronautics and Space Administration, Langley Station, VA. Langley Research Center. For primary bibliographic entry see Field 7B. W79-05862

PLANT COMMUNITIES OF ALASKAN ARCTIC BEACHES, Western Washington Univ., Bellingham. For primary bibliographic entry see Field 5C. W79-05910

NUTRIENT DYNAMICS IN NEARSHORE UNDER-ICE WATERS, Alaska Univ., Fairbanks. Inst. of Marine Science. For primary bibliographic entry see Field 5C. W79-05920

2K. Chemical Processes

ACID PRECIPITATION IN THE NEW YORK METROPOLITAN AREA: ITS RELATIONSHIP TO METEOROLOGICAL FACTORS, Interstate Sanitation Commission, New York. G. T. Wolff, P. J. Lloy, H. Golub, and J. S. Hawkins. Environmental Science and Technology, Vol. 13, No. 2, p 209-212, February 1979. 5 fig, 2 tab, 18 ref.

Descriptors: *Precipitation (Atmospheric), *Acids, *Hydrogen ion concentration, *New York, Rainfall, Snowfall, Sampling, Winds, Storms, Summer, Winter, Spatial distribution, Temporal distribution, Weather, Air pollution, Meteorology, *Acid precipitation.

A study which examined the spatial, meteorological and seasonal factors associated with precipitation pH in the New York Metropolitan Area has been completed. From 1975 through 1977, 72 events were studied. Among the 8 sites in the study, there was some site-to-site variability. The mean pH was 4.28, and the lowest seasonal values occurred during the summertime. The storms were classified according to type for each event, and

showers and thundershowers associated with cold fronts and air masses yielded the lowest pHs of 4.17 and 3.91, respectively. Closed low-pressure systems produced somewhat higher values. Air parcel trajectory analyses showed that these air mass and frontal storms were generally associated with winds from the west and southwest. These are the directions from which high emissions in the Northeast have their greatest impact on the New York Metropolitan Area. (Sims-ISWS) W79-05626

AMMONIA VOLATILIZATION LOSSES FROM FLOODED RICE SOILS, International Rice Research Inst., Los Banos, Laguna (Philippines). Dept. of Agronomy. D. S. Mikkelsen, S. K. De Datta, and W. N. Obcemea. Soil Science Society of America Journal, Vol. 42, No. 5, p 725-730, September-October, 1978. 8 fig, 10 ref.

Descriptors: *Nitrogen, Volatility, Hydrogen ion concentration, Ammonia, Submerged plants, Fertilization, Rice.

The pH of the flood water in rice fields is largely determined by the chemical equilibria that exist between the CO₂ balance achieved by the aquatic biota and the various solutes, solids, and gases in the water. Water pH values undergo diurnal changes, increasing by midday to values as high as pH 9.5-10 and decreasing as much as 2-3 pH units during the night. The pH of shallow flood water is greatly affected by the total respiration activity of all the heterotrophic organisms and the gross photosynthesis of the species present. Ammonium from fertilizers broadcast into a high pH water are highly susceptible to direct NH₃ volatilization losses. Nitrogen losses from fertilizer broadcast into flood water on a fertile, neutral-pH Maahas clay were as high as 20% of the amount applied, but losses varied depending upon water pH, the nitrogen source, and rate, time, and method of application. Losses from an acid Louisiana clay, where the flood water was not conducive to algal growth and did not exceed pH 6.8, produced NH₃ volatilization losses consistently less than 1% of the total N applied. Placement of N fertilizer in the soil at depths of 10-12 cm reduced NH₃ volatilization losses to less than 1% of the total N applied. (Skogerboe-Colorado State) W79-05812

THE FLOW MECHANISM IN THE CHALK BASED ON RADIO-ISOTOPE ANALYSES OF GROUNDWATER IN THE LONDON BASIN, Department of the Environment, Reading (England). Central Water Planning Unit. For primary bibliographic entry see Field 2F. W79-05852

EVALUATION OF THE RATE OF DECREASE IN THE IRON CONTENT OF WATER PUMPED FROM A FLOODED SHAFT MINE IN COUNTY, DURHAM, ENGLAND, Teesside Polytechnic, Middlesbrough (England). Dept. of Civil and Structural Engineering. R. C. Frost. Journal of Hydrology, Vol. 40, No. 1/2, p 101-111, January 1979. 2 fig, 1 tab, 22 ref.

Descriptors: *Water chemistry, *Mine water, *Iron, Mine drainage, Coal mines, Theoretical analysis, Regression analysis, Equations, Chemistry, Chemicals, Acid mine water, Oxygen, Pyrite, Iron compounds, Chemical reactions, Flooded mines.

An attempt was made to provide a theoretical basis for the evaluation of field data to decreasing concentrations of iron in the drainage from flooded coal mines. It was thought that this will aid the formulation and adoption of policies aimed at abating the stream pollution caused by these discharges. The removal of pyrite oxidation products from flooded mine workings was described as a convective mass-transfer process, and equations predicting an exponential decrease in their concen-

Field 2—WATER CYCLE

Group 2K—Chemical Processes

tration with time were derived from theoretical considerations. In support of this model, the concentration of Fe, C sub c (mg/l), in the water pumped from a flooded shaft mine was found to decrease with time, t (days), according to the regression equation: $\log C \text{ sub } c = 1.684 + 0.102 \log Q' - 0.00085t$ where Q' was the instantaneous pumping rate (cu m/s). The half-life of 350 days was compared with a value of 334 days calculated from literature data relating to small self-draining drift mines in the U.S.A. The practical value of the model was illustrated by estimation of the volume of ferric hydroxide sludge that might be formed in a treatment facility. (Sims-ISWS)
W79-05933

INFLUENCE OF THE CHEMICAL FORM OF MERCURY ON ITS ADSORPTION AND ABILITY TO LEACH THROUGH SOILS,

Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W79-05944

EXTRACTABILITY OF CADMIUM, COPPER, NICKEL, AND ZINC BY DOUBLE ACID VERSUS DTPA AND PLANT CONTENT AT EXCESSIVE SOIL LEVELS,

Science and Education Administration, Beltsville, Fruit Lab.
For primary bibliographic entry see Field 5B.
W79-05946

2L. Estuaries

WAVE FORCES ON CYLINDERS NEAR PLANE BOUNDARIES,

Naval Facilities Engineering Command, Washington, DC. Chesapeake Div.
J. C. Wright, and T. Yamamoto.
Journal of the Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers, Vol. 105, No. WW1, Proceedings Paper 14358, p 1-13, February 1979. 12 fig, 1 tab, 14 ref, 2 append.
NOAA 04-5-158-2.

Descriptors: *Waves(Water), *Energy, *Loads(Forces), *Pipes, Underwater, Ocean waves, Pipelines, Oceans, Coasts, Design, Engineering, Coastal engineering, Hydrodynamics, Fluid mechanics, Underwater pipelines, Cylinders.

Wave forces on a horizontal circular cylinder were measured to determine the influence of a plane boundary (e/D), water particle displacement (A/D), and water depth (h/D) on these forces. The transition from potential flow conditions to real flow conditions was considered. The variation of force coefficients of inertia, lift, and drag with respect to e/D, A/D, and h/D was identified. (Sims-ISWS)
W79-05532

PREDICTING SAND DEPOSITION AT POROUS FENCES,

B. P. Petroleum Development Ltd., Aberdeen (Scotland).
For primary bibliographic entry see Field 2J.
W79-05533

LONG WAVE MODEL INDEPENDENT OF STABILITY CRITERIA,

Hawaii Univ., Honolulu. Dept. of Ocean Engineering.
G. Niemeyer.
Journal of the Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers, Vol. 105, No. WW1, Proceedings Paper 14345, p 51-65, February 1979. 5 fig, 26 ref, 3 append. NSF DES74-23005.

Descriptors: *Bays, *Water circulation, *Waves(Water), *Model studies, *Hawaii, Mathematical models, Finite element analysis, Inlets(Waterways), Stability, Circulation, Coasts,

Currents(Water), Hydrodynamics, Estuaries, *Kaneohe Bay(HI).

Stability conditions for hydrodynamic models can be exceeded if the appropriate terms in the governing equations are approximated with implicit differences. If, in addition, the coefficient matrix for the resulting matrix equations is designed to be time invariant, an efficient simulation technique results. These features were exploited in a finite element-finite difference model of water circulation. The technique, which solves the vertically integrated Navier-Stokes equations, was used to simulate the circulation in a natural embayment where stability requirements for existing techniques would significantly restrict the size of the time step. (Sims-ISWS)
W79-05534

ESTUARINE RESEARCH: AN ANNOTATED BIBLIOGRAPHY OF SELECTED LITERATURE, WITH EMPHASIS ON THE HUDSON RIVER ESTUARY, NEW YORK AND NEW JERSEY,

Geological Survey, Albany, NY. Water Resources Div.
W. N. Embree, and D. A. Wiltshire.
Geological Survey open-file report 78-782, 1978. 58 p.

Descriptors: *Bibliographies, *Abstracts, *Publications, *Estuaries, *Hudson River, New York, New Jersey, Water quality, Tidal effects, Hydrodynamics, Model studies, Information retrieval, Information exchange.

Abstracts of 177 selected publications on water movement in estuaries, particularly the Hudson River estuary, are compiled for reference in Hudson River studies. Subjects represented are the hydraulic, chemical, and physical characteristics of estuarine waters, estuarine modeling techniques, and methods of water-data collection and analysis. Summaries are presented in five categories: Hudson River estuary studies; hydrodynamic-model studies; water-quality-model studies; reports on data-collection equipment and methods; and bibliographies, literature reviews, conference proceedings, and textbooks. An author index is included. Omitted are most works published before 1965, environmental-impact statements, theses and dissertations, policy or planning reports, regional or economic reports, ocean studies, studies based on physical models, and foreign studies. (Woodard-USGS)
W79-05593

DYE-DISPERSION STUDY AT PROPOSED PUMPED-STORAGE PROJECT ON HUDSON RIVER AT CORNWALL-ON-THE-HUDSON, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W79-05596

GRANULAR MEDIA FILTRATION OF DREDGING EFFLUENTS,

Northwestern Univ. Evanston, IL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W79-05621

DISTRIBUTION OF SUSPENDED BACTERIA IN THE NEWPORT RIVER ESTUARY, NORTH CAROLINA,

National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
A. V. Palumbo, and R. L. Ferguson.
Estuarine and Coastal Marine Science, Vol. 7, No. 6, p 521-529, December 1978. 2 fig, 3 tab, 37 ref. ERDA AT(49-7)-5.

Descriptors: *Bacteria, *Estuaries, *North Carolina, *On-site data investigations, Aquatic bacteria, Marine bacteria, Aquatic microorganisms, On-site data collections, Salinity, Organic matter, Temperature, Water temperature, Chlorophyll, Rain-

fall, Phosphates, Rivers, Tidal waters, Microscopy, Data processing, Distribution patterns, Aquatic microbiology.

Numbers of suspended bacteria in the Newport River estuary, North Carolina, during June to December 1974, were determined by direct counts using acridine orange and epifluorescent illumination on 0.45 micrometer porosity cellulose acetate filters. Bacteria ranged from 1.95 to 18.4 million cells/ml and were more abundant in the low salinity water (less than 15 parts per thousand) of the upper estuary than in the high salinity water (up to 34 parts per thousand) of the lower estuary. The inverse linear distribution of bacteria with salinity in the lower estuary suggests conservative mixing of bacteria. Preliminary observations on the distribution of relative dissolved organic matter concentration and on heterotrophic activity indicates the bacteria in the lower estuary are relatively inactive compared to the bacteria in the upper estuary and that the upper estuary may be a source of bacteria to the system. (Sims-ISWS)
W79-05623

A NOTE ON THE INTERNAL SOLITARY WAVES PRODUCED BY TIDAL FLOW OVER A THREE-DIMENSIONAL RIDGE,

University of Southern California, Los Angeles. Dept. of Aerospace Engineering; and University of Southern California, Los Angeles. Dept. of Mechanical Engineering.
T. Maxworthy.

Journal of Geophysical Research, Vol. 84, No. C1, p 338-346, January 20, 1979. 11 fig, 12 ref. ONR N00014-77-C-0015.

Descriptors: *Waves(Water), *Tidal waters, *Tides, *Model studies, Laboratory tests, Tidal effects, Flow, Internal waves, Velocity, Mixing, Density, Estuaries, *Solitary waves, Tidal flow.

Using a simple laboratory model, the mechanisms whereby a train of solitary waves can be generated by the barotropic tidal flow of a stratified fluid over a three-dimensional obstacle were clarified. As the tidal flow reaches critical value of the internal Froude number, a downstream depression is formed in the mixed layer. When the tide slackens and turns, this depression moves upstream and evolves into a sequence of solitary waves. Under some circumstances, the depression becomes turbulent, and intense mixing takes place. In this case it is also the collapse of the mixed region that generates solitary waves which mainly propagate upstream. Available field data are consistent with this explanation, and the number of waves formed using existing theory can be estimated. (Sims-ISWS)
W79-05631

INERTIAL CURRENTS IN LAKE ONTARIO, WINTER 1972-73 (IFYGL),

Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2H.
W79-05634

A THREE-DIMENSIONAL MODEL OF LAKE ONTARIO'S SUMMER CIRCULATION, II. A DIAGNOSTIC STUDY,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W79-05635

THE MODELING OF TIDAL FLOW IN A CHANNEL USING A TURBULENCE ENERGY CLOSURE SCHEME,

Reading Univ. (England). Dept. of Meteorology.
B. Johns.
Journal of Physical Oceanography, Vol. 8, No. 6, p 1042-1049, November 1978. 5 fig, 3 tab, 10 ref, 1 append.

Descriptors: Tidal waters, *Channel flow, *Rivers, *Estuaries, *Model studies, Mathematical models,

Saline Water Conversion—Group 3A

Tides, Tidal effects, Tidal streams, Flow, Roughness (Hydraulic), Turbulence, Energy, Mathematics, Analytical techniques, *Tidal flow, Turbulence energy.

A parameterization scheme was developed that is suitable for the modeling of turbulence in marine systems, and application was made to the determination of the tidal structure in an elongated channel. The model was used to investigate the practicality of the frequently employed depth-integrated technique, and conclusions were drawn about the customary bottom stress parameterization inherent in that approach. Additionally, it was shown that the value of the roughness length of the elements at the floor of the channel is of importance in determining the frictional dissipation in the model, and an evaluation was made of the tidally induced residual flow in the channel. (Sims-ISWS W79-05637)

SEASONAL CHANGES IN OXYGEN UPTAKE BY SETTLED PARTICULATE MATTER AND SEDIMENTS IN A MARINE BAY, Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab. B. T. Hargrave.

Journal of the Fisheries Research Board of Canada, Vol. 35, No. 12, p 1621-1628, December 1978. 4 fig, 3 tab, 36 ref.

Descriptors: *Bays, *Canada, *Bottom sediments, *On-site investigations, *Oxidation, Chemical oxygen demand, Biochemical oxygen demand, Sedimentation, Sediments, On-site data collections, Organic matter, Seasonal, Coasts, Water quality, Oxygen demand, Carbon, Respiration, *Nova Scotia, *Bedford Basin (Nova Scotia).

Oxygen consumption by material deposited in sediment traps suspended at different depths in a coastal marine bay was highest during summer. Seasonal changes in respiration (Formalin sensitive oxygen uptake) were significantly correlated with organic content, and highest rates on a dry and organic weight basis occurred during summer. There was no consistent depth-related change in oxygen uptake, but seasonal changes in respiration were significantly correlated over consecutive 10-m depth intervals between 20 and 60 m. Rates of respiration and chemical oxidation by undisturbed sediment cores from 60 m, which were maximum during late summer, were not related to seasonal changes in temperature or dissolved oxygen concentration. A 1-2 month delay existed between the deposition of particulate matter with maximum rates of oxygen consumption and maximum oxygen uptake by bottom sediments. Similar seasonal changes and calculation of the carbon equivalent of sediment respiration, however, showed that oxidation of settled organic matter is largely complete within the year of deposition. (Humphreys-ISWS) W79-05638

LOSS RATES OF SUSPENDED MATERIAL SEDIMENTED IN A MARINE BAY, Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab. S. Taguchi, and B. T. Hargrave. Journal of the Fisheries Research Board of Canada, Vol. 35, No. 12, p 1614-1620, December 1978. 2 fig, 2 tab, 25 ref.

Descriptors: *Bays, *Sedimentation, *On-site investigations, *Water quality, *Canada, Coasts, Analytical techniques, Methodology, Estuaries, Carbon, Chlorophyll, On-site data collections, Deposition (Sediments), Suspension, Settling velocity, *Nova Scotia, *Bedford Basin (Nova Scotia), Phaeophytin.

Loss rates for particulate carbon, nitrogen, chlorophyll a, and phaeophytin during the year in a coastal marine bay were calculated by comparison of sedimentation rates and suspended concentration of particulate matter available for deposition. Daily loss of carbon and nitrogen at various depths (1-6% with maximum values during late summer and autumn) generally decreased with depth and

was highest when fecal pellet deposition increased during late summer. Loss rates of plant pigments were an order of magnitude lower than those of carbon and nitrogen, except when algal cells settled directly during winter. The observations substantiate previous assumptions that on a daily basis only a small proportion of suspended material is sedimented. Loss rate is dependent on the nature of the suspended particulate matter and physical structure of the water column. (Humphreys-ISWS) W79-05639

ORIGIN OF DEPOSITED MATERIAL SEDIMENTED IN A MARINE BAY, Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab. B. T. Hargrave, and S. Taguchi. Journal of the Fisheries Research Board of Canada, Vol. 35, No. 12, p 1604-1613, December 1978. 5 fig, 4 tab, 38 ref.

Descriptors: *Bays, *Sedimentation, *Organic matter, *Canada, *Water quality, On-site investigations, Estuaries, Sampling, Sediments, Water temperature, On-site data collections, Suspension, Carbon, Nitrogen, Chlorophyll, Seasonal, Analysis, Deposition (Sediments), Biomass, Productivity, *Nova Scotia, *Bedford Basin (Nova Scotia), Phaeophytin.

Suspended and sedimented particulate carbon, nitrogen, chlorophyll a, and phaeophytin were measured at various depths throughout the year in a small marine bay. Seasonal and vertical differences in sedimentation rates were not simply related to changes in concentration of suspended particulate matter. Chlorophyll a/total pigment, carbon/nitrogen, and carbon/chlorophyll a ratios in suspended and sedimented material were usually different. Sedimentation rates generally increased with depth with greatest increases during periods of low stratification. Resuspension and horizontal transport of sedimenting material were implied by discontinuities in sedimentation at particular depths. Annual sedimentation of particulate carbon at 20 m depth (below the seasonal thermocline) was equivalent to 15% of the estimated supply from photosynthetic and chemosynthetic production, river discharge, and sewage input. Material deposited during periods of stratification, however, which coincided with high rates of primary production and increased zooplankton biomass during the summer, contained high amounts of carbon and chlorophyll a with a low carbon/nitrogen ratio indicative of a supply from biological production. Although a small fraction of the total suspended particulate matter annually available was deposited, large differences in the quantity and quality of sedimented material occurred seasonally. (Humphreys-ISWS) W79-05640

NEW YORK BIGHT WATER STRATIFICATION—OCTOBER 1974, Lamont-Doherty Geological Observatory, Palisades, NY. For primary bibliographic entry see Field 1A. W79-05682

MORPHOLOGIC EVOLUTION AND COASTAL SAND TRANSPORT, NEW YORK—NEW JERSEY SHELF, National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs. For primary bibliographic entry see Field 2J. W79-05684

DEVELOPMENTAL TESTS ON THE USE OF FLUORESCENT TRACERS AND BACKWASH SEDIMENT-LOAD SAMPLERS TO MEASURE THE BEACH DRIFT COMPONENT OF LITTORAL TRANSPORT AT SANDY HOOK, NEW JERSEY, Teachers Coll., New York. Dept. of Science Education. For primary bibliographic entry see Field 2J. W79-05688

BACTERIAL FLUX IN SOME NEW JERSEY ESTUARINE SEDIMENTS, Rutgers - The State Univ., New Brunswick, NJ. Dept. of Microbiology, and Rutgers - The State Univ., New Brunswick, NJ. Marine Sciences Center.

C. D. Litchfield, J. P. Nakas, and R. H. Vreeland. In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Vol. 2, p 340-353, 1976. 6 fig, 4 tab, 30 ref. NSF-GA-32440.

Descriptors: *Baseline studies, *Bacteria, *Sediments, Bottom sediments, Estuaries, Water pollution effects, *Outer Continental Shelf, *New York Bight, Estuarine processes.

From July 1972 through December 1974 ten sampling trips were made in Raritan Bay and Sandy Hook Bay to obtain estuarine sediments. The cores were subsectioned at approximately 10-cm intervals and each section was analyzed for pH, Eh, carbon, nitrogen, percent moisture, total aerobic colony forming units, and facultatively anaerobic colony forming units. Replica plate technique was used to determine the inorganic and organic nitrogen requirements of the cultured aerobic colonies. Sedimentary bacterial populations exhibit wide fluctuations in total numbers (up to five orders of magnitude), relative population components, and inorganic nitrogen requirements. These fluxes cannot be correlated overall with season, sediment particle size, nitrogen or carbon content, pH, or Eh. Although the general trend of high bacterial numbers in silt-clay sediments exists, the marked decrease in total and specific bacterial flora at station 15 makes it impossible to consider this an absolute principle for estimating bacterial numbers and potential for activity in marine sediments. (Sinha-OEIS) W79-05704

SALINITY DEPENDENT DISTRIBUTION OF BENTHIC ALGAE IN ESTUARINE AREAS OF ICELANDIC FJORDS, Slovenaka Akademija Znanosti in Umetnosti, Ljubljana (Yugoslavia). Biological Inst. For primary bibliographic entry see Field 5C. W79-05745

QUALITY OF SELECTED WATERS IN SOUTHERN MAINE, Maine Dept. of Environmental Protection, Augusta. Bureau of Water Quality Control. For primary bibliographic entry see Field 5B. W79-05832

LONGSHORE TRANSPORT AT A TOTAL LITTORAL BARRIER, Coastal Engineering Research Center, Fort Belvoir, VA. For primary bibliographic entry see Field 2H. W79-05838

DETECTION OF HEAVY METAL POLLUTION IN ESTUARINE SEDIMENTS, Florida State Univ., Tallahassee. Dept. of Oceanography, and Florida State Univ., Tallahassee. Florida Resources and Environmental Analysis Center. For primary bibliographic entry see Field 5B. W79-05850

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

PARAMETRIC STUDY ON BRACKISH WATER MEMBRANE DESALTING PLANTS, Burns and Roe Industrial Services Corp., Paramus, NJ.

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

S. V. Cabibbo, D. B. Guy, A. Ko, A. Ammerlaan, and R. Singh.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 080. Price codes: E20 in paper copy, E07 in microfiche. Report, 1979, 3 Vol, 1885 p, 4 append. OWRT (No. 7544)(1), 14-34-001-7544(1).

Descriptors: *Pretreatment requirements, *Base case desalting costs, *Major cost center analysis, *Proposed development program, Reduced pressure cases, Independent parameter costs, Large plant case cost analysis, Process diagrams, Power recovery system, Inter-stage pressure boosting, *Desalination, *Membrane processes, *Reverse osmosis, *Electrodialysis, Brackish water.

A detailed engineering and economic study was undertaken on spiral wound and hollow fiber reverse osmosis module designs and a tortuous path electrodialysis stack design used in membrane desalting plants with product water capacities of 1, 5 and 10 million gallons per day. The minimum pretreatment required, based on each of the six brackish waters, was determined to achieve water recoveries of 70, 80 and 90 percent. The preferred pretreatment was acidification. Plant layout arrangements, process flow and piping and instrumentation diagrams were prepared in detail for use as a basis for preparing capital and annual cost estimates. The impact of reduced pressure operation, interest rate, electric power cost and membrane life on product water costs was determined. The cost data indicated that membranes and modules averaged 26.5% of total capital costs and 19.4% of annual costs. Operating and maintenance labor required 23.4% of annual costs while electricity and chemicals were 13.8% and 11.9% respectively. A research and development program was outlined to reduce costs and improve reliability.

W79-05501

BIBLIOGRAPHY OF PUBLICATIONS ON COMPOUNDS OF GAS HYDRATE TYPE,

Pittsburgh, Univ., PA.
For primary bibliographic entry see Field 10C. W79-05572

RESEARCH INVESTIGATIONS OF MULTIPLE-EFFECT EVAPORATION OF SALINE WATERS BY STEAM FROM SOLAR RADIATION,

Battelle Memorial Inst., Columbus, OH.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 377. Price codes: A02 in paper copy, A01 in microfiche. OSW Summary of Research and Development Progress Report No. 2, December 1953. 6 p, 2 tab.

Descriptors: *Desalination, *Desalination processes, *Solar stills, *Multiple-effect evaporation, Desalination apparatus, Cost estimates, Operating costs, Unit costs, Water costs, Feasibility studies, Sea water, Saline water, Solar radiation, Evaporation, Water treatment, Water purification, Water quality, Equipment.

A project entailing a preliminary study in two parts of the feasibility of producing distilled water from sea water using multiple-effect evaporation and steam generated in solar collectors is summarized. In Part one the amount of solar energy available for collection with various types of collectors and concentrators was determined, and cost estimates of \$4 to \$5/sq ft were obtained from preliminary designs. Operating data and investment and operating costs for multiple-effect evaporators varying in size and number of stages were obtained in Part two. Costs of the piping joining the collector elements and the still were also estimated. When these costs were combined with the solar energy collector costs it was determined that plant size should be such that 40,000 gallons/hr of distilled water be produced to minimize labor costs; a six to eight effect flash type still would give the lowest overall cost. It is concluded that fresh water could be produced with the equipment and technology available (1953) at a cost of \$3.25/1000 gallons. (Davison-IPA)

W79-05573

RESEARCH ON VAPOR REHEAT AND LIQUID-LIQUID HEAT EXCHANGE,

FMC Corp., Santa Clara, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 538. Price codes: A06 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 78, September 1963. 104 p, 26 fig, 10 tab, 3 append. 14-01-0001-234.

Descriptors: *Desalination, *Desalination apparatus, *Desalination processes, *Liquid-liquid heat exchange, *Vapor reheat, Distillation, Heat exchangers, Mass transfer, Salinity, Water treatment, Water quality, Water quality control, Equipment.

A two column liquid-liquid heat exchanger system and a five stage, direct contact, vapor reheat distillation system have been designed, constructed, initially tested, operated as separate units, and operated as a completely integrated desalination system. The data obtained from both components is sufficient for a preliminary pilot plant design. The data, statistically correlated, predict performance and optimum dimensional requirements for the heat exchangers, and are presented graphically. Mass transfer and product salinity data for the distillation column are presented in graphic and tabulated form. In the heat exchanger system, minor design changes are expected to result in improved performance in the fresh water cooler. Further experimental work is necessary on the sea water heater, because its performance was below expectations. Mass transfer coefficients for the distillation system were in the range predicted from previous experiments. For production rates up to 1000 lbs/hr the product salinity was below 500 ppm. The process and test equipment are described; operating problems are discussed. (Davison-IPA)

W79-05574

DESALINATION BY ELECTROSORPTION AND DESORPTION,

Southern Research Inst., Birmingham, AL.
R. E. Lacey, and E. W. Lang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 683. Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 106, July 1964. 41 p, 8 fig, 6 tab, 3 ref. 14-01-0001-335.

Descriptors: *Desalination, Desalination processes, *Demineralization, *Electrosorption, Electrochemistry, Physicochemical properties, Membranes, Membrane processes, Coatings, Films, Saline water, Salinity, Sodium chloride, Cost analysis, Estimated costs, Capital costs, Amortization, Water treatment, Water quality, Water quality control.

The membrane process for demineralizing saline water, electrosorption, was studied on a laboratory scale to determine whether demineralization occurs by electrosorption, to study the theoretical basis for the process, and to estimate its economic feasibility. Three types of composite membranes were used in demineralization experiments, and coated membranes were developed for experimental evaluation of the process. It was shown that saline water can be demineralized efficiently by electrosorption at a cost possibly lower than that for electrodialysis. Product water containing 400 ppm of sodium chloride can be produced from feed water containing 3500 ppm. The time necessary for the regeneration portion of the cycle requires 35 to 40% of the total cycle, less than the time required for demineralization. Very little product water was lost due to hold up of solution within the demineralizer at times of voltage reversal. Electrosorption membranes possessing good electrochemical properties were produced by coating base films with condensation-type ion-exchange resins and curing the coatings. Preliminary estimates of the cost of demineralization by electrosorption were made and compared to costs of electrodialysis. The major saving anticipated for the electrosorption process

over electrodialysis is in amortized capital costs. (Davison-IPA)
W79-05575

THE MINIMUM REQUIREMENTS FOR SEA WATER CONVERSION PROCESSES,

State Univ. of New York at Albany.
G. W. Murphy, R. C. Taber, and H. H. Steinhauser.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-251 888. Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 9, April 1956. 78 p, 7 fig, 4 tab, 4 ref, 5 append.

Descriptors: *Desalination, *Desalination processes, *Energy, *Energy conversion, *Energy loss, Energy transfer, Thermodynamics, Heat transfer, Vapor compression distillation, Water treatment, Water quality, Water quality control, Sea water.

The ultimate of idealizations of desalination processes were studied thermodynamically to: (1) classify the methods on the basis of thermodynamic criteria; (2) show that regardless of the method, the minimum thermodynamic work is the same; and (3) approximate the energy requirements as a basis for studying real processes. Rate phenomena, part of every process, are analyzed and lead to the approximation of energy requirements for specific methods. Calculations were performed for compression distillation and the electrical separation process. In each of these the practical minimum energy requirement is estimated at four times the thermodynamic minimum, except for the losses in energy conversion devices and water transport requirements. This is regarded as a crude approximation when compared to the exact theoretical approximations. Since it is difficult to judge how much a further reduction in idealization would raise the energy value, further work is recommended. (Davison-IPA)

W79-05576

SALINE WATER CONVERSION DEMONSTRATION PLANT, WEBSTER, SOUTH DAKOTA: FIRST ANNUAL REPORT,

Mason-Rust, Webster, SD.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 680. Price codes: A07 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 101, March 1964. 131 p, 18 fig, 17 tab, 4 ref. 14-01-001-225.

Descriptors: *Desalination plants, *Evaluation, *Brackish Water Conversion Demonstration Plant No. 3, *Electrodialysis, Scaling, Equipment, Capital costs, Operating costs, Desalination processes, Desalination apparatus, Water treatment, Water quality, Water quality control, Pretreatment(Water), Brackish water, Webster(SD).

Part I presents maintenance, operational history, and technical, economic and administrative evaluations of the 250,000 gpd Brackish Water Conversion Demonstration Plant No. 3 in Webster, South Dakota, for the period March 9, 1962 through June 30, 1963. The usage of Calgon, aeration of the feedwater, membrane polarization and scaling, and the incorporation of polarity reversal into the Asahi process were among the process problems encountered. Among the equipment failures were moisture absorption and distortion of dilution compartment gaskets, sludge carryover from the iron/manganese removal filter units, and pump failures including city-owned water delivery and waste disposal pumping equipment. The cost figures given were affected by the process difficulties and the resulting interruptions in plant production. In Part II, the principles of electrodialysis are discussed; plant construction and the following plant components are described: pretreatment equipment, electrodialysis equipment, electrical system, instrumentation, and miscellaneous equipment. The plant operation and problems encountered during initial operation of the plant are summarized. Capital costs for Demonstration Plant No. 3 are compared with normalized capital costs for a 250,000 gpd plant. (Davison-IPA)

Saline Water Conversion—Group 3A

W79-05577

REMOVAL OF SCALE-FORMING COMPOUNDS FROM SEA WATER

Grace (W.R.) and Co., Clarksville, MD. Research Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 118. Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 57, February 1962. 94 p, 16 fig, 26 tab, 5 ref, 4 append. 14-01-001-202.

Descriptors: *Desalination, *Pre-treatment(Water), *Descaling, *Fertilizers, Ammonium compounds, Phosphates, Scaling, Economic feasibility, Sea water, Trace elements, Water analysis, Water chemistry, Water treatment, Water quality, Water quality control, Desalination plants.

The formation of scale deposits of calcium and magnesium salts cause malfunction and loss of efficiency in the operation of distillation equipment. Calcium and magnesium were removed from sea water by precipitation of the insoluble phosphates, magnesium ammonium phosphate and dicalcium phosphate, which have value as fertilizer. Therefore, an investigation was undertaken to determine the economic feasibility of preparing a high analysis fertilizer from the elements removed during the pretreatment of raw sea water. The fertilizer produced from the scale forming elements was a mixture of magnesium ammonium phosphate, calcium hydrogen phosphate, and the trace metal phosphates, iron, zinc, copper, manganese, cobalt, and nickel; it was non-burning and non-leaching. The precipitation process developed, low cost sodium phosphate was produced from fertilizer grade phosphoric acid and mixed with sea water. The addition of ammonia caused the precipitation of solids which were allowed to settle from the water. The descaled sea water was ready to be used in a water conversion plant. A slurry of the precipitated solids, i.e., fertilizer, was dehydrated by heating, then filtered, washed and dried. Assuming a descaling plant of one mgpd capacity, the fertilizer produced would have to command a price twice that of conventional farm fertilizers and be marketed as a specialty fertilizer. (Davison-IPA)

W79-05578

DEMON-SOUTH

INVESTIGATION AND DEVELOPMENT OF AN ELECTROLYTIC SYSTEM FOR THE CONVERSION OF SALINE AND BRACKISH WATERS

ESB, Inc., Yardley, PA.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 929. Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 51, August 1961. 56 p, 28 fig, 5 tab. 14-01-001-190.

Descriptors: *Desalination, *Membrane processes, *Ion exchange, *Desalination apparatus, Conductivity, Water treatment, Water quality, Water quality control, Resins, Plastics, Saline water, Brackish water, Energy.

Work on electrolytically conducting ion exchange materials and an investigation of electrolytic regeneration with a type of mixed bed apparatus are summarized. Graphite-ion exchange resin polyethylene and graphite cloth impregnated with ion exchange materials were tested to determine whether their electrolytic regeneration was less economical than electrolytic regeneration of a conventional resin. Chemical regeneration of the conventional resin was the most effective and economical. It was found that generally electrolytic regeneration of ion exchange materials modified to impart electronic conductivity was less economical than electrolytic regeneration of conventional resins. A membrane-type mixed bed that could be operated with continuous electrolytic regeneration was constructed. The desired degree of desalting was achieved by regulating the flow rate and current. The energy required/volume of water treated

was much higher than for desalination with multiple membrane electro dialysis units. (Davison-IPA) W79-05579

DEMINEALIZATION OF SALINE WATER THROUGH PRESSURIZATION CYCLES WITH ION EXCHANGE MATERIALS

Western Independent Research Lab., Inc., Los Angeles, CA.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 485. Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 75, July 1963. 33p, 4 fig, 10 tab, 32 ref. 14-01-001-238.

Descriptors: *Desalination processes, *Pressure, *Pressurization cycles, Saline water, Sea water, Deminealization, Energy conversion, Energy, Desalination, Water treatment, Ion exchange, Water purification, Water quality, Water quality control.

Mechanical pressure applied to ion exchange materials equilibrated with saline solution produced an effluent with greatly reduced salt concentration. With a final pressure of 6255 psi a concentration of 0.7 molar sodium chloride was reduced to 0.01 molar in four cycles. Deminealization of sea water was accomplished in two cycles by utilizing a fractional procedure whereby the second half of the effluent from that cycle was a satisfactory product. The energy requirements for this process were no greater than those for present distillation processes. The partial success of hydraulic pressurization of ion exchange materials in first generation equipment was significant, because of the cost reduction possible in the construction of hydraulic rather than mechanical pressurization equipment. (Davison-IPA)

W79-05580

HEAT TRANSFER IN THE LTV EVAPORATOR: AN ANALYSIS OF PILOT PLANT DATA AND PREDICTIVE TECHNIQUES FOR PLANT OPERATION AND DESIGN

Pregle, Dukler and Crump, Inc., Houston, TX.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 484. Price codes: A06 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 74, June 1963. 99 p, 16 fig, 11 tab, 32 ref.

Descriptors: *Desalination, *Desalination processes, *Long tube vertical evaporator, *Heat transfer, Pilot plants, Temperature, Operations, Design criteria, Tubes, Resistance, Water treatment, Water purification, Wrightsville Beach(North Carolina).

Heat transfer data obtained on a seven tube Evaporator unit in a pilot plant facility at Wrightsville Beach, North Carolina, were compared with theoretical heat transfer coefficients. The good agreement shown was also shown to depend on the validity of an assumed relationship for pressure drop in the tube under vacuum. On the basis of the study it was concluded that: (1) two phase pressure drop in the tube is significant causing substantial changes in temperature and in T driving force; (2) overall coefficient cannot be calculated from terminal conditions; (3) overall coefficients do not drop markedly in the low pressure effect; (4) steam side resistances were larger than those on the saline side under many operating conditions in the pilot plant; and (5) entrainment in the two inch tube, as high as 30% at high vacuum conditions, may be expected to cause dry spotting and/or excess local concentrations which could cause scaling. The study indicates that optimum plant design cannot be achieved by using the same tube diameters and lengths for all effects. When pressure drop and entrainment rates can be accurately determined it will be possible to select a distribution of tube size and lengths which will produce optimum performance in a multi-stage system. (Davison-IPA)

W79-05581

DEVELOPMENT OF THE DIRECT FREEZE SEPARATION PROCESS

W. J. Hahn, R. C. Burns, R. S. Fullerton, and D. J. Sandell.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 703. Price codes: A07 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 113, June 1964. 122 p, 27 fig, 2 tab, 3 append. 14-01-0001-286.

Descriptors: *Desalination, *Desalination processes, *Direct freeze separation process, *Vapor adsorption, Pilot plants, Water treatment, Water quality, Standards, Evaluation, Separation techniques, Freezing, Costs, Cost analysis, Economic feasibility, Sea water, Brines, Water costs, Wrightsville Beach(North Carolina).

Further evaluation of the 15,000 gpd pilot plant at Wrightsville Beach, North Carolina, was carried out to determine the technical and economic feasibility of the direct freeze-separation process of the primary refrigerant type for the desalination of sea water. The primary refrigerant type of direct freezing may be further classified into the vapor compression or the vapor adsorption type. The vapor adsorption type of process was selected as the most economical way to demonstrate the basic functions of freezing and separating ice from brine. The design, operation and performance of the pilot plant are described. An evaluation of the potential economics of this process is based on a plant with a 165,000 gpd capacity. Sustained production of potable water was demonstrated using less than 5% of the total product for separation. The chemical quality of the product water met the Public Health Service Drinking Water Standards except for a higher iron content which could be reduced by filtering the final product. The bacteriological quality of the product water, which met the standards, is dependent on the pollution content of the feed water. In achieving an operating cost of \$1.00/1000 gallons, the major elements of the total operating costs must be reduced to very low levels. Fixed costs amount to \$.38/1000 gallons for each \$1.00 of plant investment/gpd of capacity. (Davison-IPA)

W79-05644

POTENTIAL USE OF CONVERTED SEA WATER FOR IRRIGATION IN PARTS OF CALIFORNIA AND TEXAS

Bureau of Reclamation, Washington, DC.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 378. Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 5, April 1954. 19 p, 2 fig, 1 tab.

Descriptors: *Water supply, *Potential water supply, *Desalination, *Irrigable land, *Arable land, Water supply development, Water requirements, Agriculture, Irrigation, Irrigation programs, Irrigation systems, Irrigation water, Water utilization, California, Texas.

An inventory of arable lands within reasonable distance from or height above the source of sea water and of more remote lands that might be served by exchange of water rights lands near the coast is presented. The areas in Texas and California which were inventoried have limited amounts of undeveloped local water supplies and limited possibilities for increasing those supplies through importing natural water. It is assumed that estimated demands for water for municipal and industrial use will be met before demands for irrigation water. Estimates of future municipal and industrial requirements were used to estimate future deficiencies of local supply. Estimates of irrigable acreages and the amounts of water they would require are presented. Much of this land had not been given prior consideration as arable because of the lack of an assured water supply. The individual California and Texas areas are discussed in terms of elevation, distance from the sea, and the local water supply. It is concluded that the ultimate water requirements of those areas surveyed exceed local supplies; that it is physically possible to meet all the future water requirements of the areas within reasonable distance and height above sea level with converted sea water; and those areas beyond the

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

assumed economic reach of the converted sea water could benefit by exchange of water. (Davison-IPA)
W79-05645

RESEARCH ON FORCED-CIRCULATION AND DROPSWISE CONDENSATION TECHNIQUES FOR IMPROVING HEAT TRANSFER RATES FOR VAPOR COMPRESSION EVAPORATORS

Yale Univ., New Haven, CT. Dept. of Engineering and Applied Science.

H. Bliss

Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 383. Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 8, October 1977. 28 p, 12 fig, 4 tab. 14-01-001-59.

Descriptors: *Desalination, *Desalination processes, *Evaporation, *Vapor compression distillation, *Dropwise condensation, Heat transfer, Sea water, Steam, Temperature, Tubes, Correlation analysis, Mathematical studies, Water treatment, Water purification, Separation techniques, Water quality.

An experimental program is reported in which measurements of overall and film heat transfer coefficients with pure water or pure NaCl brine were taken, and tests of scaling behavior were made over an extended period with synthetic sea water and Long Island Sound sea water. A forced circulation evaporator was constructed in which water and brine were heated in the tubes and evaporation was accomplished by flashing after leaving the tubes. The 204 runs included the following variables: flow rate of liquid, steam temperature, steam pressure, brine concentration, inside tube diameter, and the nature of condensation (film, dropwise and mixed). The high heat transfer coefficients obtained in forced circulation evaporation with dropwise condensation were many times as large as those obtained with the usual equipment in this field. Results indicated that dropwise condensation can be maintained without taste or odor in the water. Brine coefficients determined from these data were in agreement with the generalizations of Dittus and Boelter. However, the film condensation coefficients were about 30% higher than the theory of Nusselt. Scaling studies were done by operating the unit continuously for 760 hours, the scaling which occurred indicated an approximate 33% drop in the heat transfer coefficient in a 30-day month. (Davison-IPA)
W79-05646

THEORETICAL STUDIES OF THE BEHAVIOR OF IONS IN AQUEOUS SOLUTIONS OF MIXED ELECTROLYTES WITH RESPECT TO OSMOTIC OPERATION

Oklahoma Univ., Norman.

G. W. Murphy, and R. R. Matthews.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 486. Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 76, July 1963. 63 p, 9 fig, 68 ref, 1 tab, 1 append. 14-01-001-191.

Descriptors: *Desalination, *Membranes, *Theoretical analysis, *Osmotic process, *Permeable membranes, *Demineralization, Electrolytes, Anions, Cations, Thermodynamics, Equilibrium, Aqueous solutions, Electrochemistry, Equations.

Osmotic cell operation and ion behavior were studied through examination of various theories. The discussion of non-equilibrium processes in electrolytes and membrane systems includes phenomenological equations, entropy production and the flux of ions in an electrical field. Ion-selective membranes and the osmotic process, a system of cation- and anion-selective membranes, are described. Ion fluxes in solutions of electrolytes are discussed with regard to the density of electric current, and electrochemical potentials. A program for computer solution of the set of simultaneous first order differential equations is developed. (Davison-IPA)

W79-05647

PART I: SURVEY OF PHYSIOLOGICAL MECHANISMS OF SODIUM AND CHLORIDE ION TRANSPORT AND DESIGN OF EXPERIMENT FOR APPLICATION TO DEMINERALIZING SALINE WATERS - PART II: LABORATORY EVALUATION OF USE OF ALGAE IN SALINE WATER CONVERSION - PHASE I FINAL REPORT

Resources Research Inc., McLean, VA.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 930. Price codes: A07 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 52, September 1961. 123 p, 2 fig, 5 tab, 176 ref. 14-01-001-96 and 14-01-001-109.

Descriptors: *Desalination, *Ion transport, *Algae, *Marine algae, *Salt balance, Biological membranes, Absorption, Physiology(Animal), Physiology(Plant), Biochemistry, Saline water, Water purification, Water treatment, Water quality, Information retrieval.

In Part I, the medical biochemical and physiological literature was searched for information concerning the natural processes by which salt concentration gradients are established and maintained between organisms and their environment. Information relating to the function of the human kidney was examined in addition to information on the salt conserving actions of the sweat and secretory glands, and kidney and other animal salt-concentrating functions. The accumulation and excretion of salts in plants, single-celled organisms and tissue cells were studied. A method of utilizing algae for the conversion of saline water was proposed in which the algae would be recycled to reduce the quantity of algae that must be handled and to eliminate the generation time required to produce fresh algae. The emphasis in Part II was on a screening process to seek algae with favorable characteristics for use in saline water conversion. Over 100 species of fresh water and marine algal cultures were screened and uptake studies were conducted in the laboratory. Approximately 25% of the sodium determinations and 20% of the chloride determinations indicated that the concentrations of these ions in the test media increased 2 to 3% during the time the algae grew. It is believed that this was due to errors in compensating for the volume changes occurring in the cultures during the tests. Many species exhibited good growth, were of the proper size range, and showed good ability to concentrate sodium chloride. It is noted that the data obtained does not lend itself to detailed statistical analysis. Further study is recommended. (Davison-IPA)
W79-05648

DEMINERALIZATION OF SALINE WATER BY ELECTRICALLY-INDUCED ADSORPTION ON POROUS CARBON ELECTRODES

Oklahoma Univ., Norman.

G. W. Murphy, J. J. Bloomfield, F. W. Smith, W. E. Neptune, and J. O. Purdue.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 589. Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 92, Annual Report VI, March 1964. 81 p, 14 fig, 18 tab, 17 ref, 3 append. 14-01-001-160.

Descriptors: *Desalination, *Desalination processes, *Demineralization, *Electrodes, *Adsorption, *Carbon, Porosity, Polyelectrolytes, Cations, Anions, Water treatment, Water purifications, Separation techniques, Saline water.

Continuing research on porous carbon electrodes is reported in the following areas: (1) the bench scale demineralization unit; (2) polyelectrolyte dispersants for anion-responsive electrodes; (3) the use of polymeric binders in the preparation of cation-responsive electrodes; (4) the development of a new and faster means of characterizing electrodes; (5) testing demineralization electrodes against ions other than sodium and chloride; (6) long-term demineralization tests of electrodes; and (7) the extension

of the cell theory of electrolyte solutions to unsymmetrical electrolytes and to more concentrated solutions. Difficulties with the EPR rubber end-plate facings encountered during the 40-day shakedown run of the bench scale unit were alleviated by using sealed graphite end plates and bipolar electrodes. Studies carried out to improve anion electrode capacity included comparison of the anion-responsive effects imparted by different salts of quaternized polyvinylimidazole and polyethylenimine. Alkali washing of carbons prior to dispersion with cationic polyelectrolytes which increased the capacity of all anion-responsive electrodes studied may be adopted as standard procedure. Cation-responsive electrodes with improved stability were made with polymeric binders rather than aqueous dispersing agents. Anion-responsive electrodes made by dispersion with polyvinylimidazole hydroxide exhibit greatly improved stability over electrodes made with other salts of quaternized PVI. (Davison-IPA)
W79-05649

DEVELOPMENT OF THE SOLVENT DEMINERALIZATION OF SALINE WATER

Texas A and M Coll., College Station. Dept. of Oceanography.

R. Davison, A. F. Isbell, W. H. Smith, Jr., and D. W. Hood.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 036. Price codes: A09 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 55, September 1961. 148 p, 30 fig, 10 tab, 13 ref. 14-01-001-174.

Descriptors: *Desalination, *Desalination processes, *Demineralization, *Solvent extraction, *Liquid-liquid extraction, Solvents, Ethers, Organic compounds, Analytical techniques, Spectrophotometry, Gas chromatography, Thermodynamics, Physicochemical properties, Water purification, Water treatment, Water quality, Saline water.

The development of the liquid-liquid extraction process for desalination was continued through examination of a large group of commercially obtainable solvents. In addition, a number of amines, ethers, alkylphosphonamides, and pyrroles were constructed and examined in a similar manner. By mixing two amines with near ideal properties solubility curves of almost ideal characteristics were obtained. Triethylamine - methyldiethylamine gave solubility curves which permit the process extraction temperature to range between 18 and 55. Mixed amines have solvent properties nearly ideal for brackish water conversion. Results calculated from model scale investigations of various solvents were almost identical to those obtained from calculations of heterogeneous equilibrium data. A technical and economic evaluation of the Texas A and M Solvent Extraction Process pertaining to saline water conversion indicated that the technical phases of the overall process were valid and the cost of producing 1,000 gallons of water in a 10 million gpd plant would be about \$1.12. Although the spectrophotometric method developed was satisfactory for analysis, it was not applicable to continuous observation of amine content of water on a process stream. An analysis of amine solvents to determine the effects of structure on thermodynamic factors enabled the prediction of solubility curves from knowledge of vapor pressure in the single liquid phase region of the solubility curve. (Davison-IPA)
W79-05650

DESIGN, CONSTRUCTION, FIELD TESTING AND COST ANALYSIS OF AN EXPERIMENTAL ELECTRODIALYSIS DEMINERALIZER FOR BRACKISH WATERS

Ionics, Inc., Watertown, MA.

J. P. Dankese, T. A. Kirkham, G. Maheras, M. S. Mintz, and J. H. Powell.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 386. Price codes: A09 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 11, December 1956. 144 p, 26 fig, 31 tab. 14-01-001-66.

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Saline Water Conversion—Group 3A

Descriptors: *Desalination, Desalination processes, *Electrodialysis, On-site investigations, Separation techniques, Membranes, Scaling, Acidity, Alkalinity, Costs, Estimated costs, Water treatment, Water quality, Water purification, Brackish water.

A 1,000 gph experimental apparatus capable of reducing the salinity of brackish water with 4,000 ppm dissolved solids to 350 ppm was built and tested. The first tests, of six months duration, were in Arizona where the unit operated on an irrigation water supply with 4,000 ppm dissolved salts. Fouling or plugging of the membranes and flow channels occurred, and membrane strength deteriorated. Calcium carbonate scaling was found to be the major cause of plugging; the condition was controlled by adjustments in the acidity or alkalinity of the water. The second set of tests, of three months duration, was on a municipal water supply from a deep well with 2,000 ppm dissolved salts in Miller, South Dakota. The operating procedures developed in Arizona and the use of new type membranes reduced the fouling difficulties, but did not eliminate them completely. It was found that the amount of treated water obtained from a quantity of brackish water was limited by the difficulty soluble salts present, such as calcium sulphate. These field tests demonstrated that the electrodialysis process could be used to reduce the salinity of the waters to below 350 ppm. Cost estimates were made for the 25,000 gpd field unit and extrapolated for larger plants with 1,500,000 gpd and 75,000,000 gpd capacities. Cost estimates based on field results were six times higher than estimates based on laboratory results. Chemical analysis of the water to be treated must be taken into consideration in future planning and evaluating the process for various applications. (Davison-IPA)
W79-05651

ANNUAL REPORT (FY 1969) FREEPORT TEST FACILITY AND VERTICAL-TUBE-EVAPORATOR TEST BED PLANT, FREEPORT, TEXAS, Stearns-Roger, Inc., Denver, CO.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-200 581, Price codes: A08 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 559, 1969, 112 p, 7 fig, 23 tab, 5 ref, 1 append. 14-01-0001-1804.

Descriptors: *Desalination plants, Desalination processes, *Long-tube vertical distillation, *Desalination, Water purification, Mechanical equipment, Hydraulic machinery, Economics, Capital costs, Operating costs, Cost analysis, Cost comparisons, Evaluation, On-site investigations, Corrosion, Construction materials, Evaporation, Demonstration Plant No. 1, Freeport (Texas).

A wide variety of information, findings, and recommendations concerning the Long-Tube Vertical (LTV) multiple-effect evaporation method of desalination employed by Demonstration Plant No. 1, Freeport, Texas, is presented. The technical, logistical and economic evaluations for fiscal year 1969 operations are discussed in addition to the process and mechanical development program results as related to the LTV process in particular and desalination in general. Capital and operating costs are compared to theoretical normalized capital and operating costs. Production and maintenance costs averages are presented, and relevant operating and maintenance experience are discussed. A technical evaluation of the existing process includes the 5-effect module, the mechanical equipment, and construction materials. The detailed process evaluation includes presently defined limitations of the temperatures and concentration ratios for scale-free operation LTV evaporators without presoftening the feedwater. The operations of the single effect test evaporator, the auxiliary test unit, are analyzed and discussed. Test results of newly installed equipment of advanced design are presented. (Davison-IPA)
W79-05652

FREEDZING PROCESS STUDIES, Syracuse Univ., NY. Dept. of Chemical Engineering and Materials Science.

D. J. Fontagne, H. Mason, J. E. Bajolle, R. A. Rice, and A. J. Barduhn.
OSW Research and Development Progress Report No. 501, December 1969. 93 p, 19 fig, 14 tab, 51 ref, 4 append. 14-01-0001-1135.

Descriptors: *Freezing, *Desalination processes, *Porous media, *Porosity, *Permeability, *Anisotropy, Crystallography, Crystals, Isotropy, Physical properties, Activated carbon, Separation techniques.

In a study of anisotropy in porous media, a two dimensional permeability cell was developed which can be used to measure beds with a wide range of permeabilities. Additional two dimensional permeability data was obtained on beds of mica flakes and activated carbon particles in which the horizontal permeabilities are approximately twice as high as the vertical permeabilities. The experiments performed with the cell show that spherical particles matched the numerical study of the flow equation in the isotropic case. It is concluded that the calibration curve is correct, because the solution of the flow equation in the anisotropic cases is calculated in a manner similar to the isotropic case. The apparatus is only limited in use for use with large particles because of the wall effect, and for small particles by the size of the screen openings. Conclusions concerning porous media include: (1) spherical glass particles form only isotropic beds and all asymmetric particles settle into anisotropic beds; (2) the degree of anisotropy is independent of the porosity or degree of compaction; (3) for the same material the degree of anisotropy increases when the particle size decreases because of the more irregular shape of the smaller particles; and (4) flat mica particles formed a medium with the permeability along the bedding plane being twice the amount as the permeability across the bedding plane. (Davison-IPA)
W79-05653

RESEARCH ON LIQUID-LIQUID EXTRACTION FOR SALINE WATER CONVERSION, Texas A and M Coll., College Station. Dept. of Oceanography.
R. Davison, L. M. Jeffrey, U. G. Whitehouse, and D. W. Hood.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 396, Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 22, December 1958. 8 p, 15 fig, 11 tab, 4 ref. 14-01-001-77 and 14-01-001-60.

Descriptors: *Desalination, *Desalination processes, *Desalination apparatus, *Liquid-liquid extraction, Solvents, Adsorption, Solvent extractions, Separation techniques, Equilibrium, Saline water, Sea water, Water treatment, Water purification, Heat transfer.

A series of screening tests was conducted on a variety of liquid organic solvents in a search for the most efficient solvent or solvents to be used in the desalination of sea water. The correlation of solvent properties with molecular structure and solvent purity were given special attention. Detailed data was obtained on phase equilibrium of the most promising compounds. Of the methods investigated for the recovery of solvents from the brine and product water, liquid-liquid extraction and adsorption on activated carbon and clay were studied. Although the laboratory model was too small for the collection of data which could be used in designing a larger unit, it enabled comparisons of solvents as to flooding rates, extraction rates, ease of phase separation, and served as a check on performance calculated from phase equilibrium data. Preliminary engineering cost estimates were made based on a liquid-liquid extraction plant processing 20 million gpd of sea water with 35,000 ppm total solids to produce 10 million gpd of product water with 500 ppm solids and 10 million gpd of waste water containing 70,000 ppm solids. The total estimated cost of product water was \$1.98/1000 gallons. Tertiary-octylamine was considered the best solvent for use at this time. The introduction of a liquid heat transfer medium in place of the concentric piping system could reduce

the costs associated with the heating cycle. Further cost reductions could be achieved through utilizing larger, more efficient extractor systems. (Davison-IPA)
W79-05654

DEMINEALIZATION OF SALINE WATERS: A PRELIMINARY DISCUSSION OF A RESEARCH PROGRAM, Bureau of Reclamation, Denver, CO. Engineering and Research Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 373, Price codes: A07 in paper copy, A01 in microfiche. Report October 1952. 69 p, 2 tab.

Descriptors: *Desalination, *Desalination processes, *Bibliographies, *Patents, Energy, Vapor compression distillation, Evaporation, Flash evaporation, Crystallization, Solar distillation, Adsorption, Sublimation, Osmosis, Ion exchange, Ultrasonics, Hydration, Precipitation, Electrolysis, Permselective membranes, Fuels, Nuclear energy, Deminealization.

A summary of available information (1952) on deminealization of saline is presented as a beginning outline of physical, chemical and electrical processes and phenomena, and energy sources to be used in formulating a comprehensive Saline Water Research Program. The potential separation processes and phenomena and energy sources for deminealization are discussed. A chronological bibliography of deminealization methods containing 217 references is provided. An index of potential separation processes and phenomena, an index of potential energy sources for deminealization, an author index, and a patent index are included. (Davison-IPA)
W79-05655

THE PROPERTIES OF GAS HYDRATES AND THEIR USE IN DEMINEALIZING SEA WATER, Syracuse Univ. Research Inst., NY.

A. J. Barduhn, H. E. Towilson, and Y.-C. Hu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 031, Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 44, September 1960. 73 p, 8 fig, 10 tab, 39 ref, 1 append. 14-01-001-177.

Descriptors: *Desalination, *Hydrates, *Hydrate processes, *Hydration, Physicochemical properties, Thermal properties, Physical properties, Deminealization, Sea water, Crystallization.

The properties of hydrate systems were studied by collecting data from the literature; experimental work on pressures and temperatures of which hydrates form; and by determining the other thermodynamic properties, such as heats of formation, composition, and effects of dissolved salt. More than 20 new compounds were screened by determining their critical decomposition temperatures and pressures; phase diagrams were worked out for three of the more promising hydrate formers: Freon 31 (CH₂ClF), methyl bromide, and Freon 21 (CHCl₂F). Although these agents have good potentialities in a desalination process, work is continuing to find more suitable agents and to evaluate them. The properties of hydrates are examined and the experimental work is reported. (Davison-IPA)
W79-05656

DISPOSAL OF SALINE WATER CONVERSION BRINES - AN ORIENTATION STUDY, Louis Koenig - Research, San Antonio, TX.

L. Koenig.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 394, Price codes: A07 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 20, 1958. 115 p, 24 fig, 18 tab, 84 ref. 14-01-001-92.

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

Descriptors: *Ultimate disposal, *Desalination wastes, *Brine disposal, Evaporation, Injection, Pipelines, Transportation, Saturation, Capital costs, Operating costs, Saline water, Salinity, Waste disposal, Waste treatment, *Costs.

The processes of potential use for the ultimate disposal of the waste brines resulting from conversion of saline water to fresh water were investigated. The twelve disposal processes considered, compounded out of eight unit operations, were: (1) pipeline to the sea; (2) solar evaporate the wastes to saturation and pipeline to the sea; (3) solar evaporate to complete dryness and convey by railroad to the sea; (4) pipeline to a land dump; (5) evaporate to saturation and pipeline to a land dump; (6) evaporate to dryness and freight to a land dump; (7) solar evaporate to dryness and abandon in situ; (8) inject the waste to underground formations; (9) solar evaporate to saturation and inject; (10) pipeline and inject in an abandoned oil well; (11) evaporate to saturation and pipeline to abandoned oil well; and (12) discharge to streams in times of flood. The costs of the unit operations were made for a standard set of parameters selected to represent the median values of the parameters to be expected in practice. The costs of one set of processes depends upon the concentration of the original waste, while the cost of another set is independent of the concentration. Each unit operation is discussed in terms of operating experience, investment costs, and operating costs. Each of the disposal processes is discussed; the cost of each is presented. (Davison-IPA)

W79-05657

THE STUDY OF IONIC SOLVATION, Pennsylvania Univ., Philadelphia.

For primary bibliographic entry see Field 1A. W79-05658

PRODUCING SELECTIVELY INFRARED-REFLECTING SURFACES ON PLASTIC FILMS FOR SOLAR STILLs.

Franklin Research Center, Philadelphia, PA. R. A. Erb, E. Thelen, and F. L. Jackson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 035. Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 53, October 1961. 36 p, 12 fig, 1 tab, 3 ref. 14-01-001-206.

Descriptors: *Desalination, *Desalination processes, *Solar distillation, *Solar stills, Infrared radiation, Coatings, Films, Feasibility, Economic feasibility, Technology, Research and development.

A discussion of the basic considerations of radiant energy behavior in solar stills is presented along with conclusions as to the limitations of still design on the use of selectively infrared-reflecting coatings. The two classes of infrared coatings examined are thin metal films and single and multiple-film types of interference reflection filters. It is generally concluded that metal films are not technically feasible because they will not conserve energy, and that while interference coatings are technically feasible, they are not economically feasible. (Davison-IPA)

W79-05659

DEVELOPMENT OF PLASTICS SOLAR STILLs.

Bjorksten Research Lab., Inc., Madison, WI.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 398. Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 24, February 1959. 33 p, 12 fig, 2 tab, 1 append. 14-01-001-64.

Descriptors: *Desalination, *Desalination processes, *Solar stills, *Solar distillation, Desalination apparatus, Plastics, Films, Condensation, Distillation, Evaporation, Surfactants, Design criteria, Evaluation.

A research program testing plastic solar stills and plastic materials was conducted in the laboratory and out of doors in a southern climate similar to the climate of actual operation of solar distillation units. Rigid plastics were too expensive to use as construction materials, and testing of semi-rigid plastics was discontinued because of their low yield and brittleness. A standard greenhouse-type still was developed to evaluate plastic films under conditions simulating the working conditions of larger stills of the same type. Various surface active agents were applied to the surface of several plastics to provide a good wettable surface approaching that of well cleaned glass. The only material giving near the desired results was an alcohol solution of partially hydrolyzed polyvinyl acetate. After six months testing only the double layer of polyvinylidene-chloride-vinyl chloride copolymer remained in good condition although the film had darkened and the outer layer was almost opaque. Five other types of stills were designed and fabricated in the effort to produce a still of adequate design. The suspended envelope still was designed after evaluations of the previous designs revealed their operating difficulties and inefficiencies. The suspended envelope type still was considered to be the most practical because of its yield, ease of installation, wind resistance and ease of repair. (Davison-IPA)

W79-05660

DEMINERALIZATION OF SALINE WATER BY ELECTRICALLY-INDUCED ADSORPTION ON POROUS GRAPHITE ELECTRODES.

Oklahoma Univ., Norman.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 129. Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 45, September 1960. 58 p, 6 fig, 9 tab, 28 ref, 1 append. 14-01-001-160.

Descriptors: *Desalination, *Desalination processes, *Desalination apparatus, *Demineralization, Anion, Cation, Electrodes, Electrochemistry, Electrolysis, Graphite, Acids, Water treatment, Water purification, Saline water, Carbon, Estimated costs, Cost analysis.

Anion-responsive electrodes were prepared from treated graphites and combined in demineralization cells with chemically improved cation-responsive electrodes. The goals of this investigation were to develop greater capacity for cation-responsive electrodes and to develop methods to achieve anion-responsive electrodes. Three approaches to the modification of the electrochemical properties of graphite were studied: the incidental or deliberate modifications imparted by the dispersing agent; severe chemical treatment, such as oleum or nitric-sulfuric acid mixture; and adsorption on the carbon of redox molecules with predictable electrochemical properties. Other variables investigated were different types of starting carbons and mechanical compression of electrodes. Cost estimates of saline water demineralization using the anion-reversible and cation-reversible electrodes fabricated from these chemically treated graphites deposited on Dacron felt were made. It is concluded that chemical treatment with concentrated sulfuric-concentrated nitric acids yielded the highest capacities; improved electrode characteristics were obtained through refinement of dispersion techniques; and the preliminary cost estimates indicated the economic feasibility of the process to be comparable to or less expensive than electrodialysis with ion exchange resins. (Davison-IPA)

W79-05661

FIRST ANNUAL REPORT: SALINE WATER CONVERSION PLANT NO 1, FREEPORT, TEXAS.

Stearns-Roger, Inc., Denver, CO.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 466. Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 71, January 1963. 66 p, 6 fig, 2 tab, 2 append. 14-01-001-218.

Descriptors: *Desalination, *Desalination plants, *Desalination processes, *Long-tube vertical multiple effect evaporation, Demonstration Plant No. 1, Freeport(Texas), Corrosion, Equipment, Sea water, Water treatment, Water purification, Research and development, Evaporation, Scaling, Water yield.

Technical, economic, and administrative evaluations of the Long-Tube Vertical (LTV) multiple-effect evaporation method of desalination employed by Demonstration Plant No. 1, Freeport, Texas, are reported for the period April 1961 to June 1962. The technical studies, primarily of the research and development type, were carried out during operation, maintenance and testing. The difficulties encountered during the period were due to equipment malfunctions, with equipment corrosion, brine carryover and misapplied equipment being the major areas hampering effective and sustained operation. Process malfunctions were very limited, and the few malfunctions that did occur were corrected by a combination of equipment and process modifications. Because of the malfunctioning equipment and unstable operating conditions, maintenance costs for this first year were higher than expected. Production costs vs production rates and operating costs vs production are illustrated in graphic form. Among the technical conclusions are: (1) carbon steel gives unsatisfactory service in heat exchanger tubes, tube sheets, baffles, and piping when exposed to non-deaerated sea water; (2) the specified paint for this plant is unsuitable for the corrosive atmosphere prevailing in the Freeport area; and (3) mill scale should be removed from the insides of the carbon-steel equipment by pickling before start up. Conclusions concerning the process and equipment are discussed. (Davison-IPA)

W79-05662

A STUDY OF LARGE SIZE SALINE WATER CONVERSION PLANTS.

Bechtel Corp., Los Angeles, CA.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 470. Price codes: A08 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 72, March 1963. 156 p, 5 fig, 20 tab, 1 append. 14-01-0001-267.

Descriptors: *Desalination, *Desalination processes, *Desalination plants, *Design criteria, *Economic feasibility, Costs, Cost comparisons, Capital costs, Estimated costs, Electrolysis, Long-tube vertical multiple effect evaporation, Multi-stage flash evaporation, Membranes, Membrane processes, Saline water, Sea water, Brackish water, Water purification, Water treatment.

The effect of plant size on the costs of producing fresh water from saline and brackish water was investigated through studying three types of demonstration plants in operation: the Long Tube Vertical (LTV) multiple effect evaporation process at Freeport, Texas; the Multi-stage Flash Evaporation (M-SF) process at San Diego, California; and the Electrodialysis (E/D) process at Webster, South Dakota. All three plants were normalized with respect to common design and site criteria; instrumentation was modified for automatic plant operations; and the data from predictable results of demonstration plant operations and the special test program were extrapolated for larger size production plants. To develop comparative alternative fuel costs for the larger size plants fuel oil costs of \$2.00/barrel were assumed on the basis of large fuel deliveries, and natural gas fuel costs of \$0.20/10 to the sixth Btu's were assumed. Cost estimates for the large size plants were based on the engineering designs, the vendor bids obtained for all major equipment, and experience bids from manufacturers. It is concluded that capital cost reductions occur as plant capacity increases. For example, increasing the size of a normalized M-SF plant by a factor of 14 reduces capital costs/unit output/day by 47%. Other conclusions are: water costs are reduced as plant capacity is increased; the most significant cost decrease results from using natural gas as the fuel; and product water was least expensive.

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sive from the larger sized M-SF plant utilizing natural gas. (Davison-IPA)
W79-05863

PRELIMINARY DESIGN OF AN EXPERIMENTAL CONTAINERIZED FREEZE DESALINATION UNIT,

Concentration Specialists, Inc., Andover, MA.
J. Fraser, and S. Thompson.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A051 171. Price codes: A05 in paper copy, A01 in microfiche. Department of the Navy-Civil Engineering Laboratory, Port Huene, California, December 1977. 68 p, 27 fig, 9 tab, append.

Descriptors: *Desalination apparatus, *Design, *Freezing, *Potable water, *Costs, *Water supply development, Freeze desalination, Desalination, Equipment, Construction costs, Water sources, Sea water, Brackish water, Saline water, Salinity, Desalination processes, Water supply, Computer models, Model studies, Heat transfer, Heat exchangers, Melting, Washing, Pumps.

A preliminary design for a 20,000-gpd containerized indirect contact freeze desalination unit includes plans for a freezer with a defrosting cycle, a wash column, and an indirect contact melter, together with pumps, compressors, heat exchangers, and control. The project objective was to design an indirect contact freeze desalination unit able to process seawater into potable water conforming to EPA drinking water standards, and which would fit into an 8 x 20 ft ANSI container; the unit will be used at advanced military bases. Power consumption is estimated at 77 kw-hr/kgal at a nominal design point of 3.5% feed and 70F. Prototype construction cost is estimated at \$280,000. The system is designed to operate with virtually any type of sea or brackish feed water. Projected performance data are given for feed salinities of 0.5-5.0%, and feed temperatures of 40-100F. Although the scraped-surface type of freezer, which eliminates ice build-up on the heat transfer surface by continuous mechanical removal, is commonly used in chemical process industries, capital and operating costs are both prohibitively high for desalting applications; a plain tube defrosted freezer is much more economical. A computer model was developed of the desalination process, which involves freezing the saline water into brine-coated pure ice crystals, washing off the brine, and melting the ice. A heat exchanger uses outgoing melt and brine to cool incoming water. (Lynch-Wisconsin)
W79-05727

RESEARCH ON ROLE OF LIGAND MOLECULES ON IONIZATION POTENTIALS,

United Science Associates, Inc., Pasadena, CA.
S. Naiditch, R. G. Suchanek, and R. A. Williams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-199 105. Price codes: A06 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 223, December 1966. 103 p, 27 fig, 3 tab, 25 ref. 14-01-0001-424.

Descriptors: *Desalination processes, *Ionization, *Hall coefficients, *Ions, *Solvents, Solvation, Separation techniques, Energy, Cesium, Ammonia, Temperature, Electrolytes, Density, Ion transport.

To improve the understanding of the dissociation of simple ionic salts a new technique based on the preionization effect, was established for measuring the energy attachment of solvent molecules to positive ions. It was used to measure the energy of attachment of ammonia to the positive ions, Cs⁺, K⁺, and Na⁺. The results were applied to the ionization of cesium chloride in ammonia and to the solvation number of the cesium ion in ammonia. Hall effect measurements were taken to provide correlational data on the state of electrolytes in solution. Hall coefficient measurements versus temperature indicated a small variation of RH with increasing temperature. From the Hall coefficients it was possible to deduce the number density of charge carriers contributing to the charge transport and the mobilities of the positive and negative

ions. These deductions are valid in concentrated solutions. This report is in two sections: Section I contains energies of attachment and Section II contains Hall coefficients. (Davison-IPA)
W79-05864

INVESTIGATION OF CHELATION AS A MEANS OF REMOVING IONS FROM SEA WATER,

Southern Research Inst., Birmingham, AL.
R. E. Lacey, E. W. Lang, and C. E. Feazel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 260. Price codes: A02 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 42, March 1961. 21 p. 14-01-001-187.

Descriptors: *Desalination, *Pre-treatment(Water), *Chelation, *Scaling, *Economic feasibility, Resins, Water treatment, Ions, Separation techniques, Sea water, Solvent extractions, Immiscibility.

Four methods of using chelations as a treatment to remove the scale-forming ions from sea water prior to distillation processes for purification were studied: (1) forming water-insoluble chelates; (2) forming oil-extractable chelates; (3) using water-immiscible liquid ligands; and (4) chelating resins. According to the Office of Saline Water, the cost of this treatment should not exceed \$0.10/1000 gallons of product water if the methods are to be commercially useful. The results of the study indicate that it is highly improbable that any of these methods can be economically feasible because of solubility and mechanical losses of chelating agent and resin. The possibility of complexing sodium ions as well as calcium and magnesium ions was studied. It is recommended that no further consideration be given to this because of the cost of solvent losses and the difficulty of economically regenerating sodium complexes. (Davison-IPA)
W79-05868

A STUDY AND DEVELOPMENT OF THE HICKMAN SEA-WATER STILL,

Battelle Memorial Inst., Columbus, OH.
W. L. Buckel, W. D. Beck, J. R. Irwin, A. A. Putman, and J. A. Eibling.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 030. Price codes: A08 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 43, September 1960. 152 p, 59 fig, 2 tab, 9 ref, 3 append. 14-01-001-104.

Descriptors: *Desalination, *Desalination apparatus, *Badger-Hickman still, *Economics, *Water costs, *Capital costs, *Heat transfer, Estimated costs, Operating costs, Evaporation, Condensation, Amortization, Wrightsville Beach(North Carolina), Pilot plants.

The research performed on the Hickman still from November 15, 1957 through April 30, 1960, is summarized. Experimental work on the fundamental heat transfer study was performed in the laboratory using a laboratory-size unit, No. 4 still. Pilot plant tests were carried out (using sea water) on the (17,000 gpd) Badger-Hickman No. 5 still at Wrightsville Beach, North Carolina. A brief historical account of work done before November 1957 and a detailed description of the experiments conducted on the No. 4 and No. 5 stills are presented. Estimated operating costs were based on Hickman stills utilizing a single rotor column of 100,000 gpd. Variables considered were capacity, operating temperature, temperature difference between evaporating and condensing media, and rotor speed. Minimum operating costs based on a life of 20 years for the entire still were estimated at \$1.02, \$1.03, and \$1.07/1000 gallons for evaporating temperatures of 150F, 120F, and 90F respectively. Corresponding capital costs were \$1.78, \$1.85, and \$1.78/gallon/day of production. The discussion of evaporation-condensation heat transfer across a rotating surface includes the fundamentals of heat transfer of a rotating disk, overall heat transfer coefficient of a rotating disk, and the effect of operating conditions on heat transfer coef-

ficients. It is concluded that the two items contributing most to the cost of product water are power and evaporator amortization. (Davison-IPA)
W79-05869

CORROSION OF METALS IN SEA WATER,

Battelle Memorial Inst., Columbus, OH.
F. W. Fink.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 344. Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 46, December 1960. 62 p, 14 fig, 3 tab, 40 ref. 14-01-001-182.

Descriptors: *Corrosion, *Sea water, *Saline water, *Brackish water, *Pitting, *Desalination, *Metals, *Publications, Alloys, Ions, Conduction, Heat transfer, Temperature, Scaling, Steel, Iron, Aluminum, Copper, Nickel, Titanium.

The corrosion behavior of metals and other materials in sea water, diluted sea water and brackish waters was studied, with particular attention given to corrosion and scaling problems resulting from heating saline waters. Information was obtained from literature, consultations with corrosion experts, marine corrosion research, manufacturers' technical publications and Battelle Memorial Institute's marine experience. The interaction of the major factors which influence corrosive reactions is complex and none of them are considered solely in analyzing a situation. The following factors are discussed: corrosive ions, particularly chloride; conductance and salt concentration; oxygen and temperature; crevice and pitting attack; sea water flow velocity transfer; and galvanic couples. Scaling problems associated with the chemical changes occurring when sea water is heated are reviewed. The following metals are examined with regard to their performance in saline water: steel; cast iron; wrought iron; aluminum and its alloys; copper; brasses and bronzes; cupro nickels; monel stainless steels; titanium; and the special alloys, Hastelloy C and Inconel. It is concluded that the rate of attack is increased by an increase in sea water temperature; higher temperatures are generally associated with more local attack, such as pitting; and that each metal and each type of environment must be considered individually. A bibliography containing 112 entries, chronologically arranged, is provided. (Davison-IPA)
W79-05870

A NEW PROCESS FOR THE PRODUCTION OF FRESH WATER FROM SEA WATER,

Struthers Wells Corp., Warren, PA.
H. Svanoe, W. F. Swiger, J. S. Colton, J. E. Jewett, and I. B. Margloff.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 840. Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 47, June 1961. 67 p, 21 fig, 4 tab. 14-01-001-189.

Descriptors: *Desalination, *Desalination processes, *Freezing, *Struthers Wells-Scientific Design process, Desalination apparatus, Crystals, Crystal growth, Crystallization, Nucleation, Demineralization, Separation techniques, Capital costs, Operating costs, Ice, Ice-brine systems, Pilot plants, Cooling, Sea water, Water purification, Water quality, Corrosion, Scaling.

A process has been developed which successfully produces fresh water from sea water by employing direct contact between saline water and a hydrocarbon refrigerant. The Struthers Wells - Scientific Design (SW-SD) process uses techniques of controlled crystallization to produce large, uniformly sized, regularly shaped pure ice crystals. The requirements for the proper conditions to create these crystals include minimum brine undercooling, the presence of a large mass of crystals in the undercooling zone, limited nucleation, and turbulent flow to obtain good contact between undercooled brine and suspended ice crystals. Another feature of the process is conservation of energy. The SW-SD process is described and the theory of

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crystallization is reviewed. Capital and operating costs for a 10 million gallon per stream day plant are developed using the Office of Saline Water Standardization Procedure and Scientific Design Company procedure. An experimental program carried out with the pilot plant is discussed. It is concluded that: the degree of brine undercooling, slurry density, liquid velocity, and a slow approach to operating temperature at startup are important elements to control in making good crystals in an efficient manner; this freezing process is one of the lowest cost methods of converting sea water to drinking water; and although there was no evidence of corrosion or calcium bicarbonate scaling, these cannot be ruled out as future problems. (Davison-IPA)
W79-05871

INVESTIGATION OF SUPERSATURATION IN SALINE WATER CONVERSION,

Ionics Inc., Cambridge, MA.
R. M. Lurie, M. E. Berg, and A. Guiffrida.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 261. Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 48, February 1961. 59 p, 13 fig, 12 tab, 102 ref. 14-01-001-180.

Descriptors: *Desalination, *Electrodialysis, *Supersaturation, *Effluents, *Calcium sulfate, *Stability, *Additives, *Chemical precipitation, *Laboratory tests, *Nucleation, *Flocculation, *Desalination processes, *Desalination plants, *Water treatment, *Separation techniques, *Conductivity.

A literature survey and an investigation of additives in stirred flasks were employed to determine the conditions which control the allowable level of supersaturation of calcium sulfate in the waste stream of electrodialysis demineralizers. The stirred flask experiments, encompassing eight variables, were used to study the stability of calcium sulfate in supersaturated solutions, destabilizing materials, and solution conductivity. The amount and location of precipitate as a function of operating variables and additives were investigated using a laboratory electrodialysis unit. The Mark II-4, a commercial unit, was successfully operated; results from two other commercial units that performed satisfactorily under supersaturated conditions are reported. It is concluded that: supersaturated solutions cannot be handled in electrodialysis units without stabilizing additives; supersaturated calcium sulfate solutions can be readily destabilized with alum or cellulose flocculating agents, electrically or by heating; current density has some effect on the allowable level of supersaturation, but flow rate and holdup are unimportant; two different salt compositions behaved alike at the same level of supersaturation; and the precipitation of the salts in the electrodialysis unit in finely divided form may be possible to prevent clogging of the flow paths. (Davison-IPA)
W79-05872

VAPOR COMPRESSION WITH SECONDARY HEAT-TRANSFER MEDIA.

Ferguson (H. K.) Co., New York.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 090. Price codes: A07 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 56, December 1961. 124 p, 8 fig, 14 tab, 3 ref, 1 append. 14-01-001-209.

Descriptors: *Desalination, *Desalination processes, *Vapor compression distillation, *Heat transfer, *Secondary heat transfer media, *Compression, *Costs, *Cost estimates, *Capital costs, *Operating costs, *Evaporation, *Separation techniques, *Water treatment, *Water purification, *Water quality, *Saline water.

Three basic distillation processes are compared in an investigation of the use of vapor compression with a secondary fluid. The units were compared with maximum operating temperatures of 160F and 212F. Compression ranges, distillation rates, heat transfer, energy requirements and costs are given

for the standard vapor compression cycle, multiple effect evaporators, vapor compression with multiple-effect evaporators, and a vapor compression unit with secondary fluid. Capital and operating costs were developed for the various units operating at 160F with surface costs of \$8.10 and \$6.72/sq ft, heat transfer coefficient of 500, steam costs of \$35/1000 lbs for compression units and \$0.318/1000 lbs for the multiple-effect evaporator. The results of the investigation indicate that a vapor-compression type unit producing water by distillation from fuel yields the lowest cost product. A vapor compression cycle using a secondary fluid produces lower cost water than the cycle compressing water vapor. The freeon compression unit costs are higher than the multiple-effect evaporator. It is concluded that the compression cycle using a secondary fluid warrants consideration as a means of saline water conversion. (Davison-IPA)
W79-05873

EVALUATION OF A THIN-FILM SEA WATER DISTILLATION UNIT FOR MARINE AND SHORE BASE APPLICATION.

General Electric Co., Burlington, VT.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 041. Price codes: A08 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 54, October 1961. 155 p, 61 fig, 5 tab, 3 append. NObS-78202(1734 A).

Descriptors: *Desalination, *Desalination apparatus, *Thin films, *Fluted-tube wiped film evaporator, *Evaluation, *Distillation, *Heat transfer, *Water purity, *Temperature, *Scaling, *Condensation, *Desalination processes, *Water purification, *Water treatment, *Separation techniques.

The fluted tube, wiped-film evaporator was tested and evaluated to determine its characteristics and capabilities. Performance and anti-scaling capabilities were determined in investigating the best combination of factors in the evaporator which will ultimately lead to a compact distillation apparatus for marine use. Details of the work in the following areas are presented: investigations of the evaporating and condensing surfaces; overall performance; a 130 hour run on natural sea water to determine service heat transfer performance; a 24 hour record of capacity and purity of fresh water; and an estimate of the volumetric size of an 8,000 gpd distillation plant based on the overall surface heat transfer coefficient obtained after the 130 hour run. The conclusion include: a constant high rate of distillation was achieved by the unit operating on sea water at an overall temperature difference of 27F and temperature of 170F; product purity of less than 1 ppm was achieved; the brine distillate ratio of 1.35 was adequate to maintain the performance; approximately 1/4 HP total wiper power would be required by an 8,000 gpd still; and an 8,000 gpd two-effect thin film evaporator for marine application would require a space 4 ft x 4 ft x 6-1/2 high. (Davison-IPA)
W79-05874

RESEARCH ON THERMOELECTRIC HEAT PUMPS,

Whirlpool Corp., St. Joseph, MI. Research Labs. E. F. Cox.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 543. Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 79, November 1963. 41 p, 13 fig, 2 tab, 14-01-001-256.

Descriptors: *Desalination, *Desalination processes, *Desalination apparatus, *Heat pumps, *Conductivity, *Electrical conductance, *Resistivity, *Conductors, *Distillation, *Water treatment, *Equations, *Materials, *Electrical resistance, *Thermal conductivity, *Heat transfer.

The adaptation of heat pumps based on the Peltier principle to distillation processes is discussed. These heat pumps require two dissimilar materials which have low electrical resistivity and low thermal conductivity; both materials should have large

'thermoelectric power' of opposite sign. Since these pumps have no mechanical moving parts and work best against small temperature differential, they would be advantageous in distillation processes. Mathematical calculations and physical theory are used to prove that usage of Peltier semiconductor materials in a large distillation plant may not be cost prohibitive. Four potential methods of fabricating and joining short thermoelements are considered. Pyrolysis experiments and cathodic sputtering of thermoelectric semiconductors are examined. A construction method for short-element Peltier thermal pumps is explained. It is concluded that theoretically Peltier thermal pumping appears promising in improving the efficiency of distillation processes. (Davison-IPA)
W79-05875

DEMINERALIZATION BY TRANSPORT DEPLETION,

Southern Research Inst., Birmingham, AL.
R. E. Lacey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 544. Price codes: A05 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 80, November 1963. 91 p, 23 fig, 7 tab, 18 ref, 1 append. 14-01-001-229.

Descriptors: *Desalination, *Desalination processes, *Transport depletion, *Membrane processes, *Ion transport, *Membranes, *Cation exchange, *Anion exchange, *Separation techniques, *Water treatment, *Quality control, *Water quality control, *Water purification.

Transport depletion, a variant of electrodialysis, uses only one type of ion exchange membrane, either a cation-permeable or anion permeable. The enriched solutions are separated from the depleted solutions by films permeable to both cations and anions. Part A summarizes the important findings from November 1, 1961 to October 31, 1962. In Part B the experiments are reported in detail; descriptions of the apparatus, techniques and difficulties are included. Appreciable demineralization occurred in the transport depletion process. The new type of sleeve construction developed overcomes the disadvantage of stagnant liquid layers between membranes and sleeves of the original design; it retains the advantage of almost 100% membrane utilization and lower cost construction. Theoretical expressions were developed that described the measurable parameters of performance, however, experiments indicated that some parameter or parameters not accounted for in the theoretical expression strongly influenced demineralization performance. Cost data indicate that the transport depletion process has the potential to demineralize water at a lower cost than electrodialysis, and that it will eliminate the difficulties of polarization damage to anion-permeable membranes. (Davison-IPA)
W79-05876

AN INVESTIGATION OF THE USE OF ACOUSTIC VIBRATIONS TO IMPROVE HEAT TRANSFER RATES AND REDUCE SCALING IN DISTILLATION UNITS USED FOR SALINE WATER CONVERSION,

Southwest Research Inst., San Antonio, TX.
I. A. Raben, G. Commerford, and R. Dieter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-171 911. Price codes: A08 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 49, March 1961. 163 p, 46 fig, 26 tab, 18 ref, 2 append. 14-01-001-188.

Descriptors: *Desalination, *Acoustics, *Vibrations, *Heat transfer, *Desalination processes, *Desalination apparatus, *Distillation, *Reynolds number, *Flow, *Turbulent flow, *Films, *Scaling, *Calcium sulfate, *Sea water, *Viscous flow, *Boiling, *Water treatment, *Separation technique, *Laboratory tests.

The technical feasibility of using acoustic energy to improve the economy of evaporator operation in saline water conversion has been demonstrated.

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The improvement in water side heat transfer coefficients using acoustic vibrations in the viscous and turbulent flow ranged from 450% at a Reynolds number of 540 to 16% at a Reynolds number of 16,000. It is felt that by utilizing larger vibration equipment greater improvement can be obtained at higher flow Reynolds numbers. Data obtained with the experimental unit were correlated using both vibration and flow Reynolds number parameters. The study of acoustic vibration effects on steam condensate film heat transfer coefficient showed a 57% improvement in the heat transfer coefficient at a frequency of 75 cps and an amplitude of 0.2 in, which represents a potential 30% increase in evaporator capacity. The effect of vibration on the formation of scale on a heat transfer surface under boiling and nonboiling conditions was evaluated using calcium sulfate and sea water as scaling liquids. Vibration caused the scale to flake from the pipe surface, and improved heat transfer coefficients under boiling conditions. Better scale removal was obtained under nonboiling conditions. (Davison-IPA)

W79-05877

THE MECHANISM OF DESALINATION BY REVERSE OSMOSIS,

Aerojet - General Corp., Azusa, CA.
B. Keilen.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 571, Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 84, November 1963. 73 p, 18 fig, 8 tab, 52 ref, 1 append. 14-01-0001-272.

Descriptors: *Desalination, *Reverse osmosis, *Membranes, Cellulose acetate, *Fabrication, Membrane processes, Salt, Salt balance, Temperature, Physical properties, Osmotic pressure, Chemical properties, Desalination processes, Laboratory tests, Desalination apparatus, Water treatment, Separation techniques, Demineralization.

A program with the objectives of (1) understanding the mechanism whereby desalination is accomplished by the cellulose membrane, and (2) clarifying the role of each of the fabrication parameters affecting the flux and desalination characteristics of the finished membrane is reported. The principal fabrication parameters of useful desalination membranes are: (1) composition of the casting solution; (2) temperatures at which casting, drying, and immersion of the membrane are effected; (3) thermal soak as a post-treatment of the cast membranes; and (4) application of the pressure to the membrane during its use. Each of these parameters is discussed in detail and explained in terms of experimental data. The presence or absence of the membrane salt has a major effect on the flux; deviation from the following casting solution ratios has a marked but lesser effect on membrane capability: cellulose acetate, 22%; acetone, 67%; water, 10%; and membrane salt, 1%. Temperatures critical to optimum membrane capability at which casting, drying and membrane immersion are effected are: casting, -11C; drying, -11C; and immersion, 0C. A description of a proposed mechanism for water transport and the experimental evidence developed in support of the hypothesized mechanism are presented. (Davison-IPA)

W79-05878

STUDY OF ORIENTED CELLULOSE MEMBRANES FOR REVERSE OSMOSIS AND THE RELATIONSHIP BETWEEN MORPHOLOGY AND SALT REJECTION,

Gulf South Research Inst., New Orleans, LA.
J. K. Smith, F. Morton, and E. Klein.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-200 920, Price codes: A06 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 507, February 1970. 106 p, 22 fig, 16 tab, 30 ref, 3 append. 14-01-0001-1271.

Descriptors: *Reverse osmosis, *Membranes, *Structure, *Desalination, *Cellulose, Tensile strength, Mechanical properties, Chemical properties, Physical properties, Osmosis, Permeability,

Films, Thin films, Water treatment, Separation techniques, Diffusion, Selectivity.

The water and solute permeabilities of regenerated cellulose films having high degrees of orientation were studied. Orientation was induced to increase the tensile strengths of the films when wet and to substitute a homogenous surface for the cellulosic pore structure. To retard regeneration and facilitate orientation, the films were prepared by two modifications of the viscose process. It was found that the structure of the films was affected strongly by composition of the cellulose xanthate solution, composition of the coagulation and regeneration bath, and by the method of fixation. Reverse osmosis and measurements of direct osmosis, hydraulic permeability, and diffusion rates were used in characterizing solute and solvent transport. Membrane gel properties were described by gel water content measurements, phase contrast microscopy, electron microscopy and birefringence measurements. Membrane thickness was determined by an interferometer method when the samples were wet. Cross-linking agents and monofunctional substituents were used in chemical modifications of oriented membranes. Ultrathin membranes were studied on films prepared with a reactive polymer base. Acetylation of the oriented membranes was rapid and simple; loss of orientation was minor. It is concluded that mixed ethers of cellulose offer the potential of selectivity with better mechanical and biological stability. (Davison-IPA)

W79-05879

SALINE WATER CONVERSION BY FREEZING: AN INTEGRAL PROCESSING UNIT USING A SECONDARY REFRIGERANT,

Cornell Univ., Ithaca, NY. School of Chemical and Metallurgical Engineering.
H. F. Wiegandt.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 906, Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 41, August 1960. 51 p, 22 fig, 4 tab, 13 ref. 14-01-001-107.

Descriptors: *Desalination, *Desalination processes, *Freezing, *Desalination apparatus, Crystallization, Melting, Thermodynamics, Energy transfer, Hydrates, Hydraulics, Costs, Water costs, Capital costs, Separation techniques, Water treatment, Water purification, Saline water, Sea water.

The component parts of the freezing process as a method of desalination are considered separately, but with the intention that they will combine to permit operation as a single integral unit. An examination of the energy relationships and requirements of the freezing process is followed by a discussion of crystallization, washing and melting. These three components were selected for their simplicity, thermodynamic efficiency, potential for large scale operation and their compatibility to be incorporated into an experimental unit. In the design of a 10 million gpd plant the washing zone serves as a hydraulic seal between the freezing and melting zones. The unit also features a rapid freezing step, a washing operation wherein the ice bed is propelled by a hydraulic piston action, and a melting step in which the refrigerant, isobutane, is condensed directly on dumped bulk ice. This plant, requiring 11.8 Btu/lb of product, has an estimated product cost of \$0.38/1000 gallons; the plant cost is equivalent to \$0.67/daily gallon. (Davison-IPA)

W79-05880

RESEARCH ON SALT WATER PURIFICATION BY FREEZING,

Applied Science Labs. Inc., State College, PA.
A. Rose, and T. B. Hoover.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-161 382, Price codes: A04 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 7, September 1955. 57 p, 11 fig, 19 tab. 14-01-001-69.

Descriptors: *Desalination, *Desalination processes, *Freezing, *Ice-water interfaces, Entrainment, Brines, Crystallization, Laboratory tests, Cooling, Filtration, Separation techniques, Water purification, Water purity, Melting, Water treatment, Saline water, Sea water.

In the absence of information regarding the events which take place during partial freezing of saline water, systematic small-scale partial freezing experiments were undertaken. Variations were made of the cooling rate, the length of the cooling period, the type of agitation, the material and size of the container, and the initial concentration of the salt solution. The ice was separated from the solution in each experiment by draining or filtration, with ice melting reduced to a minimum. The weights of the original salt solution, the mother liquor, the filtered ice and entrained liquid were determined. The salt content of both the ice and the mother liquor was determined; limited value was given to experiments unless substantially all the original water and salt were accounted for in the products. Other experiments were conducted using counter current washing, filtration with filter cakes of varied thicknesses, surface active agents, and centrifuging. The conclusions drawn relate to (1) the presence of entrained or adhering mother liquor as the source of salt contamination; (2) the degree of contamination of the filtered or drained ice; (3) the rate of formation of actual ice; (4) the inherent lack of reproducibility of the draining and filtration operations; and (5) the similarity of results with natural sea water and a 3.5% solution of NaCl in water. (Davison-IPA)

W79-05881

RESEARCH ON CONDENSATION MECHANISMS,

Sigmatron, Inc., Santa Barbara, CA.
G. N. Steele.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-184 986, Price codes: A03 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 215, October 1966. 41 p, 8 fig, 1 tab, 17 ref, 1 append. 14-01-0001-419.

Descriptors: *Desalination, *Condensation, *Separation techniques, *Two dimensional gases, *Adsorption, Physical properties, Chemical properties, Laboratory equipment, Density, Theoretical analysis, Investigations, Water treatment, Desalination apparatus.

A study and an experimental program investigating the nature of the two dimensional gas adsorbed on solid surfaces and its role as an additional state of matter interposed between gases and solids are reported. Theoretical investigations of early work in condensation are discussed and properties of two and three dimensional gases are compared. The goals of the experimental program undertaken were not achieved because of developmental problems in constructing and operating the equipment to be used. The operation and design of the ultra high vacuum system developed for this experimental program are described. Improvements in the equipment and employment of radioactive material are recommended before the desired adsorption data can be obtained. (Davison-IPA)

W79-05882

SEAWATER DISTILLATION APPARATUS,

H. S. Green.

U.S. Patent No. 4,131,513, 7 p, 4 fig, 4 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 4, p 1212, December 26, 1978.

Descriptors: *Patents, *Desalination, *Sea water, *Water treatment, *Water purification, *Desalination processes, Distillation, Solar distillation, Condensation, Separation techniques, Desalination apparatus.

The seawater distillation apparatus is stationarily mounted relative to a seawall and includes operational components mounted on a float which may rise and fall with the tide of the associated body of seawater. The seawater distillation apparatus uti-

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Group 3A—Saline Water Conversion

lizes electric energy as the source of heat to vaporize the seawater to be distilled. It is possible to provide the necessary electrical energy to power the apparatus from solar energy sources as well as domestic electrical energy sources. (Sinha-OEIS) W79-05958

3B. Water Yield Improvement

BIOLOGICAL RECOVERY VERSUS DESERTIFICATION,
International Livestock Centre for Africa, Addis Ababa (Ethiopia).
H. N. Le Houerou.
Economic Geography, Vol. 53, Vol. 4, p 413-420, Oct. 1977. 2 tab, 21 ref.

Descriptors: *Biodegradation, *Grazing, *Cultivation, *Irrigation practices, Saline water, Shelterbelts, Entropy, Soil moisture, Monitoring, Vegetation establishment, Reforestation, Droughts, Moisture deficit.

Desertization, a term this author prefers to the more generally recognized desertification, is analyzed here as being the result of overgrazing, overcultivation, cutting and uprooting of woody species, repetitious wildfires, and salinity or alkalinity from faulty irrigation methods. Examples of both natural and artificial recovery mechanisms from these man-animal induced pressures are discussed. Natural recovery, based on stability, resilience and entropy, depends on such biological and non-biological conditions as seed availability, soil permeability, depth and storage capacity of available moisture. Artificial means for speeding up natural recovery include increasing soil moisture retention, fertilization, ploughing, seeding species not present in the natural vegetative cover, rural village afforestation, dune stabilization, better use of saline soil and water. Water intake may be improved especially on medium to fine textured soils by scarification, contour terracing, water spreading, or by breaking hardpans such as calcrete or caliche. These interventions usually speed up biological recovery by years, but the author warns that their applicability to large-scale operations must be carefully assessed as to their economic feasibility. The use of saline water for irrigation of highly resistant fodder species is under study in several areas, but require efficient drainage systems. He is dubious about the efficacy of so-called greenbelts on a wide scale, and recommends monitoring programs to quantify what are presently scattered and qualitative observations. (Tickes-Arizona). W79-05556

3C. Use Of Water Of Impaired Quality

AN OUTLINE OF SOIL, WATER AND AGRICULTURE IN ARAB COUNTRIES,
Alexandria Univ. (Egypt). Dept. of Soil Science.
For primary bibliographic entry see Field 2A. W79-05553

EFFLUENT IRRIGATION OF COASTAL BERMUDA GRASS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman.
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol. 105, No. EE1, Proceedings Paper 14359, p 55-60, February 1979. 2 fig, 4 tab, 14 ref. EPA S800829.

Descriptors: *Florida, *Irrigation, *Sewage effluents, Waste treatment, Land reclamation, Nutrients, Effluents, Bermuda grass, Nitrogen, Phosphorus, Potassium, Weeds, Water reuse, Groundwater, Water table, Grasses, Sands, *Tallahassee(FL), Wastewater use.

Secondary effluent from the city of Tallahassee, Florida, was applied to coastal bermuda grass on lakeland fine sand. Effluent was applied through sprinklers at rates of 50 mm/week, 100 mm/week,

150 mm/week, and 200 mm/week during the period April-October. Yields and nutrient recovery were determined. Yields and nutrient uptake showed an increase with irrigation rate, while efficiency of nutrient recovery decreased. The content (dry weight basis) of dry matter, nitrogen, phosphorus, and potassium increased with irrigation rate. Recovery efficiencies for calcium, magnesium, sodium, iron, and zinc were all below 100%, indicating adequate quantities of these elements. Based on these results, nitrogen recovery of 50% to 75% would be expected at 50 mm/week irrigation rate. With proper weed control, yields of 13 mt/ha would be expected, with a harvest frequency of approximately 4 weeks. Supplemental potassium might be required since the K/N ratio of effluent usually lies below that of coastal bermuda grass. (Visocky-ISWS) W79-05624

POTENTIAL USE OF CONVERTED SEA WATER FOR IRRIGATION IN PARTS OF CALIFORNIA AND TEXAS,
Bureau of Reclamation, Washington, DC.
For primary bibliographic entry see Field 3A. W79-05645

SALT TOLERANCE IN THE WILD RELATIVES OF THE CULTIVATED TOMATO: RESPONSES OF SOLANUM PENNELLII TO HIGH SALINITY,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Biology.
For primary bibliographic entry see Field 21. W79-05813

GRAPEFRUIT RESPONSE TO VARIABLE SALINITY IN IRRIGATION WATER AND SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Environmental Physiology.
H. Bielcorai, J. Shalhevet, and Y. Levy.
Irrigation Science, Vol. 1, No. 1, p 61-70, August, 1978. 3 fig, 4 tab, 16 ref.

Descriptors: *Irrigation effects, Irrigation water, *Salinity, *Crop response, Grapefruit, Osmotic pressure, Salts, Leaching.

Results were reported from a long-term field experiment designed to determine the effect of irrigation water salinity on the yield and water uptake of mature grapefruit trees. Treatments were started in 1970 and consisted of chloride concentrations in the irrigation water of 7.1, 11.4 and 17.1 meq/l added as NaCl + CaCl₂ at a 1:1 weight ratio. For the last four years of the experiment, 1973 to 1976, yield was linearly related to the mean chloride concentration in the soil saturation extract weighted according to the distribution of water uptake with depth and time. There was a 1.45% yield reduction for each 1 meq/l increase in chloride concentration above a threshold value of 4.5 meq/l. This corresponded to a 13.5% decrease per 1 mmho/cm increase in the electrical conductivity of the soil saturation extract above a threshold value of 1.2 mmho/cm. Total water uptake was reduced as salt concentration in the soil increased. Salt accumulation in the soil depended on the quantity and salt concentration of the irrigation water, rainfall, and on the amount of leaching. No leaf symptoms of either Cl⁻ or Na⁺ injury were observed. The results indicate an osmotic—rather than a specific ion effect—of salinity on grapefruit yield. (Skogerboe-Colorado State) W79-05814

POTENTIAL FOR USING SALINE WASTE WATER FROM ELECTRICAL POWER PLANTS FOR IRRIGATION,
Utah State Univ., Logan. Dept. of Soils and Biometeorology.
R. J. Hanks, R. F. Nielson, R. L. Cartee, S. E. Ging, and P. McNeil.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 541. Price codes: A03 in paper copy, A01 in microfiche. Utah Agricultural Experiment Station Bulletin 504, March 1979. 33 p, 5 fig, 12 tab. OWRT A-037-

UTAH(1). 14-34-0001-8047.

Descriptors: *Saline water, Impaired water, *Water reuse, Irrigation water, Salinity, Utilities.

Saline waste water from the Huntington, Utah Power and Light Company plant was used to irrigate 12 crops in 1977 and 1978. Variable amounts of irrigation were applied using a line-source irrigation system. In 1978 an identical plot was established which was irrigated with fresh water from Huntington Creek. There was no decrease in crop production caused by using the saline water as compared with fresh water. There were no measurable increases in soil salinity to a depth of about 1.2 m in either plot (as measured by electrical conductivity of a saturated paste) from spring to fall in 1978 but a slight increase was measured in 1977. Solution samples taken from the soil at about 1.2 m using ceramic samplers showed evidence of a slight increase in the electrical conductivity in 1977 but not in 1978. Thus, there is evidence of chemical reaction of the soil with the saline irrigation water that caused the electrical conductivity of the root zone to remain relatively low. This is especially true in that part of the plots which was not leached. Based on the two years of field data collected, it appears feasible to use the saline waste water from the plant for irrigation for several years. When excessive soil salinity will develop is not predictable from present knowledge. W79-05829

3E. Conservation In Industry

WATER AND ENERGY IN THE WESTERN COAL LANDS,
Office of Technology Assessment, Washington, DC.
For primary bibliographic entry see Field 6D. W79-05845

3F. Conservation In Agriculture

EFFECTS OF WATER MANAGEMENT AND SOIL PHYSICAL PROPERTIES ON COTTON PRODUCTION IN THE ROLLING PLAINS,
Texas A and M University, College Station.
C. J. Gerard, and L. E. Clark.
Texas Agricultural Experiment Station, Publication No. MP-1382 C, June, 1978. 26 p, 5 tab, 11 fig, 17 ref.

Descriptors: *Soil-water-plant relationships, *Water utilization, *Soil physical properties, *Irrigation effects, *Cotton, Soil moisture, Soil compaction, Soil physics, Water management(Applied), Statistical analysis, Nitrogen, Storage capacity, Climatic data, Semiarid climates, Texas.

Cotton has long been a major crop on the semiarid Texas rolling plains and numerous studies have sought to determine the best water management systems for getting the highest yields from limited amounts of irrigation water. Reported here are the results of a moisture level-variety-fertility experiment which was conducted with cotton on ablene clay loam soil in 1976. Four moisture levels were randomized in a Latin Square design and split to include two varieties, Lockett 77-4 and Lankart 611 and three nitrogen treatments, 0, 40, and 80 pounds of N/A. Results indicated that cotton exploits only a shallow reservoir of water on many soils on the rolling plains and yields were a linear function of water additions through irrigation or rainfall during the blooming and fruiting periods. Compacted soil layers were found to reduce root growth and development and the shallow storage reservoirs on many of rolling plains soils must be replenished by rainfall or irrigation every 5 or 20 days during blooming and fruiting periods. Based upon climatological records of the area the target date for cotton planting is established to be about May 20 and tests have indicated that the Lockett 77-4 variety yields better than Lankart 611 for this area. Production practices in this region have been based largely upon tradition and further research

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on water, insects, and soil management, and variety trials are recommended. (Tucson-Arizona) W79-05557

CORN YIELDS FROM IRRIGATION WITH ADEQUATE AND DEFICIENT WATER,

Nebraska Univ., North Platte. Dept. of Agricultural Engineering. W. F. Kroul. Paper No. 78-2555, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois. 19 p, 11 fig, 2 tab, 25 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Corn, Moisture deficit, Yield equations, *Crop response, Growth stages, Evapotranspiration, Water conservation, *Irrigation efficiency.

In 1974 and 1975, the effects of varying the time and the amounts of applied irrigation water on corn yield were studied on field plots at Fort Collins, Colorado. A single irrigation sprinkler line extending through the center of each plot provided the sole source of irrigation water. With this irrigation design, the corn experienced greater water deficiency outward from the sprinkler line. In addition, irrigation water was withheld from some treatments during various growth periods throughout the season. The field plots were preplant irrigated to wet the soil profile to a depth in excess of three meters. Primary comparisons were made of actual and/or relative yields of grain and dry matter for different water application amounts and for evapotranspiration. Omitting irrigation water during certain growth periods generally reduced yields. High soil water holding capacity reduced the necessity for frequent irrigation. Omitting all irrigations during two growth periods reduced yields substantially. Adequate water was not always detrimental if omitting water was available in the soil profile to maintain adequate evapotranspiration. Of major significance was the result that, with few exceptions, regular application of less irrigation water than that required for maximum evapotranspiration produced the best water use efficiencies expressed as yield-per-unit of water consumptively used. (Skogerboe-Colorado State) W79-05803

VARIABILITY OF SPRINKLER COEFFICIENT OF UNIFORMITY TEST RESULTS,

RainBird Technical Services, Logan, UT. K. Solomon.

Paper No. 78-2010, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah. 10 p. 2 fig, 2 tab, 4 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Sprinkler irrigation, Uniformity coefficient, Irrigation efficiency, Statistical methods, Regression analysis.

Sprinkler coefficient of uniformity (UC) test results were analyzed and found to vary significantly, even under similar test conditions. The amount of anticipated variation in measured UC values was correlated with the UC value itself. Factors influencing this variation were discussed. (Skogerboe-Colorado State) W79-05805

GRAPEFRUIT RESPONSE TO VARIABLE SALINITY IN IRRIGATION WATER AND SOIL,

Agricultural Research Organization, Bet-Dagan (Israel). Div. of Environmental Physiology. For primary bibliographic entry see Field 3C. W79-05814

ANALYSIS OF TRICKLE IRRIGATION WITH APPLICATION TO DESIGN PROBLEMS,

Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics. E. Bresler.

Irrigation Science, Vol. 1, No. 1, p 3-17, August, 1978. 6 fig, 1 tab, 18 ref.

Descriptors: *Irrigation design, Water conservation, *Trickle irrigation, Flow rates, Infiltration.

An existing numerical solution to nonsteady state infiltration was used to quantify the effect of soil hydraulic properties and trickle discharge rates on emitter spacing. The results of the analysis suggested the possibility of controlling the wetted volume of a soil by regulating the emitter discharge according to soil properties. The surface distribution of a transformed soil water content (or pressure) function was derived from a linearized solution to steady infiltration. The analysis of steady and nonsteady infiltration was employed to estimate the spacing between emitters as a function of discharge and water pressure conditions between emitters using hydraulic soil data. Hydraulic conductivity parameters were given for 17 different soils which were used for design purposes. Theoretical analysis of soil water was combined with hydraulic principles to derive lateral diameter and length for engineering design requirements. (Skogerboe-Colorado State) W79-05815

A NOTE ON THE ECONOMIC SIGNIFICANCE OF UNIFORM WATER APPLICATION,

Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering. I. Seginer.

Irrigation Science, Vol. 1, No. 1, p 19-25, August, 1978. 3 fig, 7 ref.

Descriptors: *Water delivery, Prices, Costs, *Crop production, *Sprinkler irrigation, Yield equations.

A yield vs water application diagram, with uniformity of water-distribution and price of water as parameters, can be used to determine the optimum water application and the expected income for a certain crop. The diagram can further be used to explore the possible outcome of changing water uniformity and/or price. The diagram was based on simplified forms of the yield and water-distribution functions. (Skogerboe-Colorado State) W79-05816

THE EFFECT OF SUPPLEMENTAL IRRIGATION AND NITROGEN FERTILIZATION ON WHEAT (TRITICUM AESTIVUM L.),

Agricultural Research Organization, Gilat (Israel). Regional Experiment Station.

For primary bibliographic entry see Field 21. W79-05817

CENTER PIVOT IRRIGATION IN THE COLUMBIA BASIN OF WASHINGTON AND OREGON: DYNAMICS AND IMPLICATIONS,

Oregon State Univ., Corvallis. Dept. of Geography. K. W. Muckleston, and R. M. Highamith.

Water Resources Bulletin, Vol. 14, No. 5, p 1121-1128, October 1978. 1 fig, 13 ref.

Descriptors: *Sprinkler irrigation, Columbia River, Hydroelectric power, Water law, Oregon, Washington, Social impact, Economic impact.

Impacts of center pivot irrigation in the Columbia Basin were reviewed. As of 1976, over 225,000 acres were being irrigated by center pivot units in a five-county area of the basin in Oregon and Washington. Most of the development took place since 1970. Dynamic application of center pivot technology altered the concept of irrigability in the study area, converting lands that were often rolling, sandy, and plagued by wind erosion from low grade grazing to productive irrigated units. This development was entirely by private enterprise, with large corporate farms accounting for much of the effort. Little prior comprehensive planning or coordination took place. When the circulation of water is altered on such a massive scale, however, unplanned impacts may be far reaching. In this case they include: (1) acceleration of the shift to high cost thermoelectric generation, (2) alteration of state institutions designed to allocate water, and (3) possible significant alterations of the socioeco-

nomic fabric of small rural service centers. (Skogerboe-Colorado State) W79-05818

CONSERVATION AND CONVENTIONAL SYSTEMS FOR CONTINUOUS PRODUCTION OF CORN,

Iowa State Univ., Ames. Dept. of Agricultural Engineering. D. C. Erbach, W. G. Lovely, and G. E. Ayres. Paper No. 78-2517, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois. 9 p. 4 fig, 9 tab, 22 ref. ASAE, St. Joseph, Michigan.

Descriptors: Till, Soil management, Conservation, Crop production, Corn(Field), Economics, Weed control, Iowa.

Seven tillage systems were evaluated for continuous production of corn in Central Iowa on a soil from the Clarion-Nicollet-Webster Soil Association. Comparative weed control, stand establishment, surface plant residue, soil nutrient profile, yield, and economic results were discussed. (Skogerboe-Colorado State) W79-05820

SIMAZINE RESIDUE LEVELS IN IRRIGATION WATER AFTER DITCHBANK APPLICATION FOR WEED CONTROL,

Science and Education Administration, Denver, CO. Aquatic Weed Control Research Lab. For primary bibliographic entry see Field 5B. W79-05821

REDOX POTENTIALS IN A CROPPED POTATO PROCESSING WASTE WATER DISPOSAL FIELD WITH A DEEP WATER TABLE,

Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center. For primary bibliographic entry see Field 5B. W79-05822

DETERMINATION OF OPTIMAL WELL CAPACITIES FOR CONTINUOUS IRRIGATION PROGRAMS,

Washington Univ., St. Louis, MO. Center for the Biology of Natural Systems.

A. K. Sanghi, D. Johnson, and G. Kuepper. CBNS-AE-9, NSF/RA-78-0017, January, 1978. 50 p, 11 fig, 17 tab, 18 ref, 2 append, 11 eq.

Descriptors: *Irrigation programs, *Model studies, Wells, Evapotranspiration, Growth stages, Timing, Groundwater.

A method was developed to predict optimal and acceptable suboptimal well capacities using a model developed at the University of California, Davis. Net revenue values were calculated at various well capacities using a budget for a 132-acre field and an equation for determining yield reduction. The well capacities were chosen based on growth periods found to have a differential impact on corn yields. These differential effects were discussed in terms of the optimal and suboptimal well capacities that will fulfill water requirements through certain parts of the growth season. This model may provide a farmer with a predictive tool so that he may consider optimally timed water application by an optimal well capacity to maximize net revenue. In addition, it may provide information for policy makers to enact regulations, which would make the use of groundwater resources more beneficial to the society. (Skogerboe-Colorado State) W79-05823

POTENTIAL FOR USING SALINE WASTE WATER FROM ELECTRICAL POWER PLANTS FOR IRRIGATION,

Utah State Univ., Logan. Dept. of Soils and Biometeorology. For primary bibliographic entry see Field 3C. W79-05829

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation in Agriculture

SPRINKLER NOZZLE,

R. H. Keely.

U.S. Patent No. 4,132,358, 6 p, 5 fig, 6 ref; Official Gazette of the United States Patent Office, Vol. 978, No. 1, p 145, January 2, 1979.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, Application equipment, Nozzles, Irrigation practices, Irrigation efficiency.

A pop-up nozzle for an underground sprinkler system includes a spray head fastened to the top of a hollow stem which is slidably mounted within a cylindrical sleeve. The sleeve is imbedded in the ground, and its lower end is connected to a source of pressurized water. As water flows into the sleeve, the stem and spray move axially within the sleeve so that the spray head projects above ground level and allows water emanating from the spray head to clear ground obstructions. A radial projection on the stem mates with one of several circumferentially spaced axial grooves in the sleeve to fix the angular position of the spray in a predetermined direction when a unidirectional spray head is used. (Sinha-OEIS)

W79-03952

CASING MOUNTED EMITTER,

Harmony Emitter Co., Inc., Tucson, AZ. (Assignee).

R. C. Harmony.

U.S. Patent No. 4,132,364, 8 p, 8 fig, 9 ref; Official Gazette of the United States Patent Office, Vol. 978, No. 1, p 147-148, January 2, 1979.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, *Application equipment, Irrigation practices, Irrigation efficiency, Flow control, Emitters.

A casing mounted miniaturized emitter is described which discharges water under high pressure at a constant rate despite variations in water pressure. The emitter is self purging during initiation and cessation of water flow through it. The high pressure emitter will pass fluid suspension particulate matter and will convey water from the conduit to a distant location at a constant flow rate despite pressure variations within the conduit. A pair of spaced apart annular flanges define an annular channel in the orifice in the wall of the conduit. An insert has a pair of downwardly depending flexible skirts with striae on facing surfaces of the skirts and is supported by the casing. The pair of skirts regulates the size of the passageway through the emitter to maintain a constant rate of flow. (Sinha-OEIS)

W79-05953

DRIVE MEANS FOR IRRIGATION SYSTEM,

Wade (R.M.) Co., Portland, OR. (Assignee).

L. C. Olson, and G. Cornelius.

U.S. Patent No. 4,132,244, 8 p, 6 fig, 7 ref; Official Gazette of the United States Patent Office, Vol. 978, No. 1, p 105, January 2, 1979.

Descriptors: *Patents, *Irrigation, *Irrigation systems, Application equipment, Distribution systems, Irrigation efficiency.

An irrigation system includes an irrigation line mounted on wheels. The wheels may be easily and conveniently moved from respective positions perpendicular to the irrigation line to respective positions parallel to the irrigation line to allow for towing of the irrigation line as desired. Movement of the wheels provides for appropriate engagement and disengagement of gear means through which drive is provided to the wheels. (Sinha-OEIS)

W79-05954

DUAL-FUNCTION VALVE,

Irrigation Specialties Co., San Gabriel, CA. (Assignee).

C. A. Lieding.

U.S. Patent No. 4,131,235, 6 p, 6 fig, 4 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 4, p 1123, December 26, 1978.

Descriptors: *Patents, *Irrigation, *Irrigation systems, *Irrigation efficiency, Irrigation practices, Automatic control, Valves, Application equipment.

A dual-function valve assembly for an irrigation system is described which typically has sprinkler heads disposed at different elevations downstream from a control valve. A spring-loaded check valve prevents drainage of the sprinkler lines through the lower heads when the control valve is closed. A second valve in the assembly closes to prevent excessive flow if a sprinkler head is damaged or removed. The valve assembly is especially useful in unattended, automatically actuated irrigation systems. (Sinha-OEIS)

W79-05959

ADJUSTABLE BUBBLER SPRINKLER HEAD,

Nelson (L. R.) Corp., Peoria, IL. (Assignee).

J. R. Pescetto.

U.S. Patent No. 4,131,234, 7 p, 6 fig, 4 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 4, p 1123, December 26, 1978.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, *Irrigation efficiency, Irrigation practices, Flow control, Application equipment.

A sprinkler head comprising an annular sprinkler body of molded plastic has a tubular member of molded plastic snapped into operative fixed relation within the central portion. A flow adjusting screw is threaded within the tubular member and has its head in adjustable flow restricting relation to inlet passages in the sprinkler body. Water flowing through the controlled inlet passages moves upwardly along the interior of an annular wall, outwardly along an end wall of the adjusting member, downwardly between the exterior of the annular wall and the adjusting member and then radially outwardly. The axial position of the spray adjusting member determines the spray pattern which is variable from a thick umbrella sheet pattern to radially extending discrete streams. (Sinha-OEIS)

W79-05960

'CORNER PIVOT' AN EFFECTIVE CORNER WATERING SYSTEM,

Lindsay Mfg. Co., NE.

R. E. Callies.

Paper No. 78-2006, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 18 p. ASAE, St. Joseph, Michigan.

Descriptors: *Sprinkler irrigation, Irrigated land, Irrigation efficiency, Irrigation systems, Distribution systems, Irrigation design.

The 'Corner Pivot' system incorporates the use of a long span single tower center pivot irrigation machine which is attached to and pivots about the outer most tower of a conventional center pivot irrigation machine. This attachment is used to extend the reach of the standard machine for the purpose of watering the corners or irregularly shaped areas along the perimeter of the field which could not normally be reached by a conventional center pivot machine. (Skogerboe-Colorado State)

W79-05990

MATHEMATICAL MODELS AND BORDER IRRIGATION DESIGN,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.

D. D. Fangmeier, and T. Strelkoff.

Paper No. 78-2007, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 11 p. 11 fig, 4 tab, 6 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Border irrigation, Irrigation design, *Mathematical models, Runoff, Design criteria, Infiltration rates, Recession curves, Time lag, Irrigation efficiency.

A mathematical model of flow in irrigation borders assuming zero inertia was used to evaluate U.S. Soil Conservation Service design criteria for sloping borders with runoff and to demonstrate model capabilities. Model results indicated that the Soil Conservation Service design criteria are reasonable. (Skogerboe-Colorado State)

W79-05991

BORDER-STRIP IRRIGATION DESIGN—PRACTICAL APPROACH FROM A THEORETICAL BASIS,

California Polytechnic State Univ., San Luis Obispo. Dept. of Agricultural Engineering.

J. L. Merriam.

Paper No. 78-2008, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 14 p, 14 fig, 1 tab, 2 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Irrigation design, *Border irrigation, Surface irrigation, Graphical methods, Recession curves, Flow rates, Irrigation efficiency, Moisture deficit, Time lag, Infiltration.

A graphical procedure was developed for designing border-strip irrigation systems. It is based on the principle that the shape of the recession curve is relatively unchanging for any specific field, and therefore, it is the controlling key condition for design or operation. Conditions modifiable by the designer or operator to obtain high efficiency are: (1) the stream size that controls the rate of advance; (2) the Management Allowed Deficiency of soil moisture at the time of irrigation; (3) the length of the strip; and (4) the distance down the strip at which flow is cut off. (Skogerboe-Colorado State)

W79-05992

RAPIDLY OBTAINING OPTIMAL IRRIGATION SYSTEM DESIGNS,

Idaho Univ., Aberdeen.

J. R. Busch, G. D. Gallinato, C. E. Brockway, and G. E. Steinbach.

Paper No. 78-2009, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 16 p. 6 fig, 8 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Irrigation design, Irrigation systems, Optimization, *Computer programs, Computer models, Cost allocation, Costs, Dynamic programming, Linear programming.

A methodology was developed and tested that will allow irrigation planners to obtain optimal system designs. Computer routines were used to obtain costs of individual system components. The optimization procedures produce least cost designs subject to specified constraints and these constraints can easily be changed to allow rapid evaluation of alternatives. (Skogerboe-Colorado State)

W79-05993

COMPUTER MODEL FOR CENTER PIVOT SPRINKLER DESIGN,

Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.

G. L. Kelso, and A. R. Jarrett.

Paper No. 78-2003, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah, 19 p, 12 fig, 6 tab, 7 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Sprinkler irrigation, Computer models, *Computer programs, Irrigation systems, Flow rates, Uniformity coefficient, *Irrigation design.

A computer aided center pivot design program was presented. The program selected specific sprinklers and nozzles from input parameters of flow rate to the pivot, system length, sprinkler spacing and desirability of an endgun. The program also computed a uniformity coefficient for the system based on the sprinklers and nozzles selected. (Skogerboe-Colorado State)

W79-05994

WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Control Of Water On The Surface—Group 4A

THE USE OF COMPUTERS TO NOZZLE CENTER PIVOT SYSTEMS

Toro Co., Riverside, CA.
R. M. Morgan.
Paper No. 78-2002, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah. 8 p. ASAE, St. Joseph, Michigan.

Descriptors: *Sprinkler irrigation, Distribution patterns, *Computer programs, Distribution, Nozzles, Irrigation systems, Irrigation design.

The practice of irrigation by sprinkler head distribution on center pivot machines has been a system of application crops for nearly twenty years. Many types of heads and spacings have been used with a goal toward achieving more even distribution. The art of computer-use to predetermine distribution uniformity was discussed. (Skogerboe-Colorado State)
W79-05995

DETERMINING CENTER-PIVOT SPRINKLER UNIFORMITIES

Department of Agriculture, Lethbridge (Alberta). L. Ring, and D. F. Heermann.
Paper No. 78-2001, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah. 18 p, 3 fig, 6 tab, 12 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Sprinkler irrigation, Uniformity coefficient, Irrigation efficiency, Distribution patterns, *Irrigation design.

Catch can evaluations were conducted and the water application and uniformity were calculated for different can spacings and number of rows. Results were compared to each other and to a theoretical application pattern. A recommended procedure for the field evaluation of center-pivot systems was suggested. (Skogerboe-Colorado State)
W79-05996

PERFORMANCE OF CENTER-PIVOT SPRINKLER IRRIGATION SYSTEMS OPERATING AT REDUCED PRESSURES

Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
S. M. Arshad Ali, and A. D. Barefoot.
Paper No. 78-2005, Presented at the 1978 Summer Meeting of the American Society of Agricultural Engineers, June 27-30, 1978, Logan, Utah. 19 p, 4 fig, 4 tab, 14 ref. ASAE, St. Joseph, Michigan.

Descriptors: *Sprinkler irrigation, Irrigation systems, Performance, Water pressure, Low flow, Uniformity coefficient, Distribution patterns, Evaporation, Irrigation efficiency.

Spray distribution obtained from a single stationary sprinkler head was utilized to determine the effects of reduced operating pressure on evaporation loss, uniformity of application, sprinkler spacing, and application rate of a center-pivot sprinkler irrigation system. Results indicated that at reduced pressure, the sprinkler performances were satisfactory. (Skogerboe-Colorado State)
W79-05997

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

RIVER RUNOFF REGULATION AND WATER-MANAGEMENT CALCULATIONS, (METODIKA REGULIROVANIYA STOKA I VODOKHOZYSTVENNYKH RASCHETOV), P. A. Lyapichev.

Available from the National Technical Information Service, Springfield, VA 22161 as TT74-30022,

Price codes: A14 in paper copy, A01 in microfiche. TT74-30022, National Technical Information Service, Springfield, VA., 1975. 302 p, 153 fig, 15 tab, 59 ref.

Descriptors: *Rivers, *Runoff, *Regulation, *Water management (Applied), Reservoirs, Planning, Design, Water users, Annual, Precipitation (Atmospheric), Seasonal, Electric power, Powerplants, Hydroelectric plants, Statistical methods, Graphical methods, Inflow, Water quality, Discharge (Water), Foreign countries, Foreign research, Methodology, Analytical techniques, *USSR, Runoff regulation problems.

Efficient utilization of water resources is one of the major current problems of the USSR economy. Many rivers have begun to be utilized comprehensively in various major projects only during the last 10 years, mostly through runoff regulation. Runoff regulation has become an indispensable and generally accepted means of efficient utilization of rivers. Soviet scientists and engineers have solved many complex and crucial problems of runoff regulation and water-management calculation and have designed numerous hydraulic installations. In the author's opinion, detailed calendrical regime graphs and methods for their preparation are fundamental; whereas statistical methods are auxiliary, although he applies them even to complex regulation forms to which they were never previously applied. Broad subject areas presented included: (1) river runoff, water reservoirs, and general problems of runoff regulation; (2) annual runoff regulation; and (3) long-term regulation of runoff with constant and variable guaranteed outputs. (Froelich-ISWS)
W79-05544

GEOHYDROLOGICAL RESEARCH AT THE CHALMERS UNIVERSITY OF TECHNOLOGY, GÖTEBORG.

For primary bibliographic entry see Field 4C.
W79-05546

LOCAL INFILTRATION OF STORM WATER

Royal Inst. of Tech., Stockholm (Sweden). K. Cedervall, and O. Holmstrand.
In: Geohydrological Research at the Chalmers University of Technology, Göteborg; Papers Presented at the Nordic Hydrological Conference in Reykjavik, August 29 to September 1, 1976, p 33-41, May 1977. 3 fig, 4 ref.

Descriptors: *Storm runoff, *Cities, *Urban hydrology, *Infiltration, Percolation, Recharge, Pit recharge, Groundwater, Soil water, Soil water movement, Runoff, Storm water, Storms, Foreign countries, Foreign research, Urbanization, Drainage, Hydrology, Hydrogeology, *Bratthammar (Sweden), *Göteborg (Sweden), *Hälsjö (Sweden), *Percolation basins, *Sweden.

The purpose of the present research project was to analyze the hydrological and geohydrological conditions for local infiltration of storm water. This means determination of the impact on runoff in urban areas due to percolation basins and, as a consequence of this, determination of if and to what extent the dimensions of storm water pipes can be reduced. Furthermore, the purpose was to study geohydrological conditions for percolation basins with respect to infiltration of storm water and to see to what extent soil water and groundwater conditions may be affected. An essential part of the research work was studies on field installations of percolation basins in Bratthammar, Göteborg, and Hälsjö. (See also W79-05546) (Sims-ISWS)
W79-05550

WATER-SUPPLY POTENTIAL OF THE LOWER HILLSBOROUGH RIVER, FLORIDA, 1976.

Geological Survey, Tallahassee, FL. Water Resources Div.
C. L. Goetz, R. C. Reichenbaugh, and J. K. Ogle.
Geological Survey Water-Resources Investigations

78-29 (open-file report), 1978. 23 p, 6 fig, 1 plate, 6 tab, 11 ref.

Descriptors: *Water supply, *Reservoirs, *Reservoir storage, *Water quality standards, Data collections, Effluents, Water analysis, Streamflow, Inflow, Low flow, Channel morphology, Available water, Projections, *Florida, *Tampa Reservoir, *Lower Hillsborough River (FL).

The Tampa Reservoir Dam, constructed in 1945 on the lower Hillsborough River 10 miles above the mouth, provides 12.5 miles of natural channel storage for city water supply. Flow of the lower Hillsborough River and storage in Tampa Reservoir become deficient during annual dry periods. Excluding dead storage, Tampa Reservoir capacity is 2,000 million gallons at a maximum stage of 22.5 feet above mean sea level. For 20-year, annual-minimum-flow conditions, Hillsborough River flow is exceeded when the draft rate reaches 38 million gallons per day. In any year, at full capacity, Tampa Reservoir and Hillsborough River have a 3-percent chance of failing to supply at least 66 million gallons of water per day; and a 2-percent chance of failing to supply at least 59 million gallons per day. Runoff and effluent from agricultural, industrial, and urban areas enter the stream system above Tampa Reservoir. A wide range of chemical constituents, including nutrients, metals, herbicides, and pesticides analyzed in samples taken at the reservoir, are all below the maximum acceptable limits set by the U.S. Environmental Protection Agency for raw waters used for public supply. Water color exceeds the recommended level based on aesthetic considerations. The color is successfully removed through the treatment process at the Tampa water treatment plant. (Woodward-USGS)
W79-05586

SPECIAL FLOOD HAZARD INFORMATION: TURKEY CREEK, BRYAN, TEXAS.

For primary bibliographic entry see Field 2E.
W79-05716

FLOOD PLAIN INFORMATION: MAXWELL CREEK, PARKER, TEXAS.

Army Engineer District, Fort Worth, TX.
For primary bibliographic entry see Field 2E.
W79-05719

FLOOD PLAIN INFORMATION: DEER CREEK AND TRIBUTARIES, CROWLEY, TEXAS.

Army Engineer District, Fort Worth, TX.
For primary bibliographic entry see Field 2E.
W79-05720

STORM WATER MANAGEMENT FOR LITTLE LEHIGH AND CEDAR CREEK DRAINAGE BASINS.

Lehigh Univ., Bethlehem, PA.
R. L. Johnson, P. J. Usinowicz, and R. D. Reardon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 598, Price codes: A05 in paper copy, A01 in microfiche. Prepared for U. S. Dept. of Housing and Urban Development, Washington, D.C., December, 1976. 96 p, 4 append, 9 tab, 18 fig, 68 ref.

Descriptors: *Water quality, *Water pollution control, *Water quality control, *Storm runoff, *Storm water management, *Models, *Allentown (PA), *Cedar Creek (PA), *Little Lehigh Creek (PA), *Stormwater management model (SWMM), Water resources, Rainfall, Model studies, Simulated rainfall, Heavy metals, Biochemical oxygen demand, Nitrates, Coliform bacteria, Urban planning, Stream water quality, Infiltration.

This report addresses the environmental problems of urban storm water runoff in the Allentown, PA area. The study utilized extensive field surveys and water quality data to develop a first level calibration of the Storm Water Management Model

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control Of Water On The Surface

(SWMM) for the Little Lehigh and Cedar Creek drainage basins, using the College Heights Boulevard drainage system. The SWMM is separated into four computational blocks: Runoff, Transport, Storage/Treatment, and Receiving. The blocks model the rainfall and runoff, the piping network, various storage and/or treatment alternatives, and the storm water effect on the receiving water. The report discusses measurement techniques of water quality, rainfall, runoff, and storm flow. The appendices contain the results of all the stream and stormwater runoff water quality analyses, including each parameter, date and time of sample, the level of parameter for each sampling station, the development of a 10-year 3-hour design storm event, and observed rain data. Storm runoff water quality can be as poor or worse than raw sewage. This will have grave effects if the receiving body is also used as a public water supply. Many impervious areas of this drainage basin discharge storm runoff onto lawns and other pervious areas other than into the drainage system; this practice should be encouraged in new development areas. It is recommended that the City of Allentown address the problem of roof drains, driveways and other impervious surfaces and establish a policy of where this stormwater runoff should go so that planning and engineering personnel can properly design and evaluate the impacts of urban development. (Coan-NC)

W79-05721

A PHOSPHORUS BUDGET FOR LAKE BURLEY GRIFFIN AND MANAGEMENT IMPLICATIONS FOR URBAN LAKES.
For primary bibliographic entry see Field 5C.
W79-05734

BIOLOGICAL EFFECTS OF RICE-FIELD HERBICIDE MACHETE ON VARIOUS STRAINS OF THE NITROGE-FIXING BLUE-GREEN ALGA NOSTOC MUSCORUM.
Banaras Hindu Univ., Varanasi (India). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W79-05744

EFFECTS OF DRAINAGE PROJECTS ON RUNOFF FROM DEPRESSIONAL WATERSHEDS.
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
I. D. Moore, and C. L. Larson.
Paper No. 78-2504, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois. 5 p. ASAE, St. Joseph, Michigan.

Descriptors: Drainage effects, Drainage practices, Surface drainage, Subsurface drainage, Surface runoff, Subsurface runoff, Peak discharge, Small watersheds, Mathematical models, Statistical methods.

Runoff from watersheds characterized by numerous depressions was studied statistically and by use of a special purpose watershed model. Application of the model to two small watersheds indicated that drainage development increases annual runoff, storm runoff and peak discharges. (Skogerboe-Colorado State)

W79-05979

SEDIMENT MANAGEMENT CONCEPTS IN URBAN STORM WATER SYSTEM DESIGN.
Geological Survey, Reston, VA. Water Resources Div.
H. P. Guy.
In: Urban Storm Drainage: Proceedings of the International Conference held at the University of Southampton, England, p 523-535, 1978. 3 fig, 1 tab, 20 ref.

Descriptors: *Sediment transport, *Urbanization, *Storm runoff, *Sediment control, Methodology, Detention reservoirs, Drainage programs, Planning, Drainage systems, Water pollution control, Evaluation.

Storm drainage systems can be designed which will greatly reduce peak rates of runoff and the amount of sediment and pollutants normally transported from urbanization to receiving water bodies. Reduction in peak flow rates reduces the potential for serious channel enlargement and additional sediment problems downstream from the development. Optimum design can be achieved through land-use planning that is well coordinated with natural drainage. This will make it possible to minimize excavation and soil exposure during construction, and provide a maximum of individual and (or) community onsite storm water detention storage. The resulting storm drainage system would usually have a lower initial cost and result in a more esthetically pleasing neighborhood than generally exists with conventional designs. (Woodard-USGS)

W79-05981

4B. Groundwater Management

LOCAL INFILTRATION OF STORM WATER.
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 4A.
W79-05550

INJECTION OF WATER INTO WELLS FOR INVESTIGATION OF LIMITED AQUIFER.
Chalmers Univ. of Technology, Goteborg (Sweden).
L. Carlsson, and B. Kozerski.
In: Geohydrological Research at the Chalmers University of Technology, Goteborg; Papers Presented at the Nordic Hydrological Conference in Reykjavik, August 29 to September 1, 1976, p 55-66, May 1977. 13 fig, 7 ref.

Descriptors: *Injection wells, *Potentiometric level, *Groundwater, Aqueifers, Bedrocks, Piezometry, Recharge, Recharge wells, On-site investigations, Construction, Tunnels, Foreign research, Storage, Storage coefficient, Transmissivity, Geology, Hydrogeology, *Sweden.

Due to leakage in underground constructions in bedrock, decreasing piezometric head has been observed in confined aquifers in clay-filled areas in the region of Goteborg, Sweden. Water-injection tests were performed in an area with a very limited aquifer in order to prevent this decreasing. By analyzing both the injection- and the recovery-curves, it was possible to localize the leakage-point for the aquifer and the hydrogeological properties of the aquifer. (See also W79-05546) (Sims-ISWS)

W79-05552

GROUNDWATER PROJECTIONS FOR 11 BASINS.
Arizona Water Resources Research Center, Tucson.
Arizona Water Resources News Bulletin, News Bulletin 78-3, 4 p, May-June 1978. 1 fig.

Descriptors: *Groundwater resources, *Arizona, *Groundwater availability, *Groundwater basins, Water supply, Groundwater recharge, Water management (Applied), Project planning, Planning, Administrative agencies, Evaluation, Forecasting, Estimating, Arizona Water Commission, Legal aspects, Hydrologic data.

Reported here is a synopsis of the findings of the Arizona Water Commission's study on the impact of future growth on groundwater resources in 11 of the state's major basin areas. Utilizing the Department of Economic Securities population and economic growth projections and assuming no change in existing law and institutions as they relate to water and its use, the Commission reported its finding to the Groundwater Management Study Commission to aid in its task of recommending and preparing legislation for the best development, utilization and conservation of the state's groundwater. The 11 basins studied account for about 80% of the state's water depletion and include: Avra Valley, Douglas, Harquahala Plains, Little Chino Valley, Lower Santa Cruz, Safford,

Salt River, Upper San Pedro, Upper Santa Cruz, Willcox and Yuma. For each of the basins analyzed, information is supplied on pumping depths and costs, overdrafts, urban-agricultural-mining demands, Indian water rights, irrigation, diversions, and other water management considerations. The intention of this study was to provide an informational base upon which to evaluate potential groundwater management strategies and aid Commission members in meeting their responsibilities of informing interested persons of potential groundwater problems and solutions. (Tickes-Arizona)

W79-05554

GROUND-WATER LEVELS AND QUALITY DATA FOR GEORGIA, 1977.
Geological Survey, Doraville, GA. Water Resources Div.
Geological Survey open-file report 79-213, October 1978. 88 p, 5 ref.

Descriptors: *Groundwater resources, *Water levels, *Observation wells, *Georgia, *Water quality, Aqueifers, Withdrawal, Water supply, Groundwater recharge, Hydrogeology, Hydrologic data, Water level fluctuations, Hydrographs, Well data, Water utilization, Groundwater availability, Annual report.

This report begins a publication format that will present annually both water-level and water-quality data in Georgia. In this format the information is presented in two-page units: the left page includes text which summarizes the information for an area or subject and the right page consists of one or more illustrations. Daily mean water-level fluctuations and trends are shown in hydrographs for the previous year and fluctuations for the monthly mean water level the previous 10 years for selected observation wells. The well data best illustrate the effects of changes in recharge and discharge in the various ground-water reservoirs in the State. A short narrative explains fluctuations and trends in each hydrograph. (Woodard-USGS)

W79-05607

EFFLUENT IRRIGATION OF COASTAL BERMUDA GRASS.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3C.
W79-05624

EVALUATION OF GROUNDWATER FLOW AND RECHARGE THROUGH GLACIAL DRIFT, MICHIGAN STATE WATER QUALITY MANAGEMENT PROJECT, EAST LANSING, MICHIGAN.
Michigan State Univ., East Lansing. Dept. of Geology.
G. L. Larson, and J. Lovato.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 538. Price codes: A04 in paper copy, A01 in microfiche. Institute of Water Research, Michigan State University, Project Completion Report, April, 1979. 59 p. OWRT A-095-MICH(1). 14-31-0001-7048, 14-34-0001-8024.

Descriptors: *Groundwater recharge, Glacial drift, Glacial sediments, Infiltration, Michigan, Saginaw formation.

A geohydrologic study of glacial sediments underlying the spray irrigation site of the Michigan State University Water Quality Management Project demonstrates that the site is underlain by both clay till deposits and interbedded gravel layers. Aquifer testing of the drift material indicates that the average transmissivity of the gravel units is approximately 4000 gpd/ft (50 cu m/d m), while the vertical permeability of the clay units averages 0.12 gpd/sq ft (5.7 x .001 cm/sec). Observed infiltration rates (0.07 gpd/sq ft) at the site appear to be twice the rate (0.03 gpd/sq ft) calculated from the aquifer test data. The difference in the infiltration rates is primarily attributed to downward flow of water along the permeable gravel layers, which

Watershed Protection—Group 4D

are, to some degree, hydraulically connected to the underlying Saginaw Formation. Analysis of lithologic and water level data from numerous observation wells located on the research site also suggests that maximum recharge potential to the Saginaw Formation exists along the northwestern edge of the site where MSU production well drawdown is greatest and where the drift material is coarsest. W79-05791

DETERMINATION OF OPTIMAL WELL CAPACITIES FOR CONTINUOUS IRRIGATION PROGRAMS.
Washington Univ., St. Louis, MO. Center for the Biology of Natural Systems.
For primary bibliographic entry see Field 3F. W79-05825

4C. Effects On Water Of Man's Non-Water Activities

GEOHYDROLOGICAL RESEARCH AT THE CHALMERS UNIVERSITY OF TECHNOLOGY, GÖTEBORG.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 054, Price codes: A04 in paper copy, A01 in microfiche. Document D17:1977, Papers presented at the Nordic Hydrological Conference in Reykjavik, August 29-September 1, 1976. Chalmers University of Technology, Göteborg (Sweden), May 1977. 73 p. Gilbert Svensson, Editor.

Descriptors: *Storm runoff, *Groundwater, *Cities, Urbanization, Runoff, Infiltration, Permeability, Transmissivity, Water quality, Wells, Injection wells, Analytical techniques, Model studies, Mathematical models, On-site investigations, Geology, Hydrology, Hydrogeology, *Sweden.

The 6 papers in this document originally were presented at the 'Nordic Hydrological Conference' in Reykjavik, August 29-September 1, 1976. The research reported in these papers was carried out within the Urban Geohydrology Research Group at the Chalmers University of Technology. The main fields of research for this group are storm water, quantity and quality, and groundwater behavior, especially in urban areas. At the back of this document there was a list of publications published by the Urban Geohydrology Research Group. (See W79-05547 thru W79-05552) (Sims-ISWS) W79-05546

SWEDISH URBAN HYDROLOGICAL RESEARCH: A REVIEW.
Chalmers Univ. of Technology, Göteborg (Sweden).
L. Carlsson, and G. Svensson.
In: Geohydrological Research at the Chalmers University of Technology, Göteborg: Papers Presented at the Nordic Hydrological Conference in Reykjavik August 29 to September 1, 1976, p 1-13, May 1977. 2 fig, 4 ref.

Descriptors: *Urbanization, *Water resources, *Groundwater, *Research and development, Cities, Planning, Drainage, Water levels, Water balance, Runoff, Foreign research, Infiltration, Buildings, Subsidence, Land subsidence, Waste water(Pollution), Storm runoff, Sewers, Urban hydrology, *Sweden.

The process of urbanization and modern construction methods cause disturbances to groundwater conditions. Sinking groundwater levels, caused by increased drainage in combination with diminished percolation and infiltration, can result in severe damages both on ground surfaces and to buildings. Construction, combined with the exploitation of new land area, has been the dominating factor in Swedish urbanization. Maintenance and restoration of old sewer systems and new alternatives for managing storm water are branches which will be of immediate interest in future research activities concerning water and problems in connection with

water. An increased number of houses outside urban areas makes new demands on the construction of water and sewage facilities. In addition to this, there are increased demands on the quality of water from urban areas which is let out in recipients. This implies a need for treatment of water before the outlet or measures to change both amount and quality of water in the long run. (See also W79-05546) (Sims-ISWS) W79-05547

SOME RESULTS FROM URBAN RUNOFF STUDIES IN BERGSJÖN GÖTEBORG.
Chalmers Univ. of Technology, Göteborg (Sweden). Dept. of Hydraulics.
For primary bibliographic entry see Field 2A. W79-05548

LOCAL INFILTRATION OF STORM WATER.
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 4A. W79-05550

FIN ROT DISEASE STUDIES IN THE NEW YORK BIGHT.
National Marine Fisheries Service, Oxford, MD. Middle Atlantic Coastal Fisheries Center.
For primary bibliographic entry see Field 5C. W79-05702

STORM WATER MANAGEMENT FOR LITTLE LEHIGH AND CEDAR CREEK DRAINAGE BASINS.
Lehigh Univ., Bethlehem, PA.
For primary bibliographic entry see Field 4A. W79-05721

IMPACTS OF RECREATION ON RIPARIAN SOILS AND VEGETATION.
Vermont Univ., Burlington. School of Natural Resources.
R. E. Manning.
Water Resources Bulletin, Vol. 15, No. 1, p 30-43, February 1979. 4 fig, 70 ref.

Descriptors: *Recreation, *Environmental effects, *Reviews, *Riparian land, Vegetation effects, Hydrologic aspects, Infiltration, Runoff, Soil erosion, Soil compaction, Management, Riparian plants, Water resources, Recreation facilities, Camping, Natural resources, Soil impact cycle, Riparian soils.

The seemingly magnetic attraction of water resources for recreation has direct implications for proximate land resources which are needed to provide access and support facilities. This paper reviewed and synthesized the literature dealing with the impacts of recreation use on riparian soils and vegetation. Part one of the paper sets forth the major negative impacts of recreation use on soils and vegetation. A 7-step soil impact cycle was identified, beginning with the scuffing away of leaf litter and other organic material and working through the soil erosion and sedimentation process. Four major kinds of impacts of recreation use on vegetation were outlined, and the 'vicious circle' relationship between impacts on soil and vegetation was demonstrated through a Soil/Vegetation Impact Diagram. Part two identified several spatial and temporal patterns of environmental impact caused by recreation use. The node and linkage pattern of recreation use, campground and trail expansion, ground cover response and succession, rates of soil compaction, and resource response to various intensities of recreation use are important aspects. The final part of the paper dealt with measuring environmental impacts caused by recreation use. Management implications of the research findings were considered throughout the paper. (Humphreys-ISWS) W79-05843

WATER AND ENERGY IN THE WESTERN COAL LANDS.
Office of Technology Assessment, Washington,

DC.
For primary bibliographic entry see Field 6D. W79-05845

EFFECTS OF LAND USE AND WATER MANAGEMENT ON WATER QUALITY IN THE WESTERN SOUTH NEW RIVER CANAL BASIN, SOUTHEAST FLORIDA, 1974-75.
Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Geological Survey Water-Resources Investigations 78-30, March 1978. 56 p, 29 fig, 3 tab, 15 ref.

Descriptors: *Water pollution effects, *Water quality, *Land use, *Florida, *Canals, Surface waters, Groundwater, Flow profiles, Runoff, Watersheds(Basins), Path of pollutants, Salinity, Phosphates, Nitrates, Calcium compounds, Trace elements, Insecticides, Dissolved oxygen, Watershed management, *Broward County.

The South New River Canal (C-11) basin between water-control structures S-9 and S-13 is an area that is primarily undeveloped and the system of waterways within the basin is highly controlled for water-management purposes. Most of the recharge to the canals is by induced ground-water inflow and seepage. The chemical character of the surface and ground waters in inundated areas is mixed calcium-bicarbonate and sodium-chloride type. Inorganic nitrogen concentrations in surface waters are slightly higher in developed areas than in undeveloped areas. Concentrations of inorganic nitrogen in ground water in drained areas are 2-4 times greater than in undeveloped inundated areas. Average orthophosphate concentrations are uniformly low (0.01 to 0.03 milligrams per liter) throughout the basin. Total residue concentrations are fairly uniform throughout the basin and fluctuate primarily in response to hydrologic conditions. Runoff and load-discharge indices indicated that the loads of inorganic nitrogen, total residue, and phosphorus, and the discharge per unit of land drained were uniform throughout most of the basin. (Woodard-USGS) W79-05978

4D. Watershed Protection

WATERSHED INVENTORY STUDIES OF GUADALUPE MOUNTAINS NATIONAL PARK, TEXAS.
Texas Tech Univ., Lubbock. Dept. of Park Administration and Landscape Architecture.
P. A. Fuller, and E. B. Fish.
Journal of the Arizona-Nevada Academy of Science, Vol. 13, No. 2, p 39-43, June, 1978. 3 fig, 3 tab, 20 ref. OWRT B-206-TEX(1).

Descriptors: *Census, *On-site data collection, *Future planning(Projected), *Drainage effects, *Watersheds(Basins), *Analytical techniques, *Watershed management, *Environmental effects, *Ecosystems, Geological surveys, Ecological distribution, Environmental control, Biological communities, Sampling, Ecotypes, Planning, National parks, Drainage density, Soil-water-plant relationships, Drainage patterns(Geologic), Surveys, Hydrologic data, Aerial photography, Vegetation, Channel morphology.

The Guadalupe Mountains National Park in Texas, established in 1966 and covering 77,500 acres, lies in a unique ecosystem in which many animal and plant species reach their northern, southern, eastern and western-most boundaries. To insure protection of the environmental factors contributing to this unique ecosystem, a study was initiated as a basic biological inventory to provide input data upon which planning and management efforts could be directed. Initial bio-physical and cultural resource inventories have indicated the critical importance of water in this semi-arid region and have highlighted the influential basis upon which this resource must be treated. Accordingly, major drainage basins which headwater within the park were delineated and characterized in terms of areal extent, shape perimeter length, drainage density,

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4D—Watershed Protection

drainage pattern, stream order, channel profile, topography, geologic parent material, and vegetative cover. The resultant data were used to compare the various watersheds in an effort to evaluate similarities among the individual basins. Thirty-five distinct basins were initially compared from which 6 groups of watersheds were established based upon highly similar basin characteristics. A 'landscape unit approach' involving aerial photographic interpretation techniques to provide a similar grouping of watersheds was performed and was in good agreement with results obtained from the traditional data index. (Tickes-Arizona)
W79-05610

EROSION CONTROL/SEDIMENT MODELING—SOUTHERN IDAHO A PROGRESS REPORT,
Idaho Agricultural Experiment Station, Aberdeen.
For primary bibliographic entry see Field 2J.
W79-05804

SURFACE WATER QUALITY ASSOCIATED WITH THE SURFACE MINING OF IOWA COAL,
Iowa State Univ., Ames. Energy and Mineral Resources Research Inst.
For primary bibliographic entry see Field 5B.
W79-05834

IMPACTS OF RECREATION ON RIPARIAN SOILS AND VEGETATION,
Vermont Univ., Burlington. School of Natural Resources.
For primary bibliographic entry see Field 4C.
W79-05843

THE SUSPENDED SEDIMENT REGIME OF AN OREGON COAST RANGE STREAM,
Pacific Northwest Forest and Range Experiment Station, College, AK. Alaska Region.
For primary bibliographic entry see Field 2J.
W79-05846

SEDIMENT MANAGEMENT CONCEPTS IN URBAN STORM WATER SYSTEM DESIGN,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W79-05981

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

NATIONAL URANIUM RESOURCE EVALUATION PROGRAM (NURE), HYDROGEOCHEMICAL AND STREAM SEDIMENT RECONNAISSANCE IN THE EASTERN UNITED STATES,
Du Pont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.
R. B. Ferguson, and V. Price, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as DP-MS-75-114, Price codes: A03 in paper copy, A01 in microfiche. Report DP-MS-75-114, April 1976. 26 p, 10 fig, 3 tab, 10 ref. ERDA AT(07-2)-1.

Descriptors: *Water chemistry, *Appalachian Mountain Region, *Sediments, *Uranium, *United States, *Sampling. Data collections, On-site data collections, On-site investigations, Chemical analysis, Suspended solids, Streams, Projects, Spectroscopy, Groundwater, Chemicals, Analysis, Surveys, Water quality, *Blue Ridge Mountains, Energy Research and Development Administration.

A geochemical reconnaissance of 25 eastern states for uranium will be conducted by the Savannah River Laboratory for the Energy Research and Development Administration. A sound technical

basis for the reconnaissance is being developed by intensive studies of sampling, analysis, and data management. Results of 3 orientation studies in the southern Appalachian Piedmont and Blue Ridge areas indicated that multi-element analysis of -100 mesh (less than 149 micrometers) stream sediments will provide adequate information for reconnaissance. Stream and groundwater samples also provide useful information, but they are not considered cost-effective for regional reconnaissance in the areas studied. (Sims-ISWS)
W79-05520

GROUNDWATER SAMPLING IN URANIUM RECONNAISSANCE,
Union Carbide Corp., Oak Ridge, TN. Nuclear Div.
T. R. Butz.
Available from the National Technical Information Service, Springfield, VA 22161 as CONF 770314-13, Price codes: A02 in paper copy, A01 in microfiche. Report, March 1977. 5 p, 2 fig, 1 ref.

Descriptors: *Groundwater, *Uranium, *Water chemistry, *Sampling, Wells, Water wells, Springs, Data collections, On-site data collections, On-site investigations, Chemical analysis, Instrumentation, Water quality, Chemicals, Data processing.

The groundwater sampling program conducted by the Oak Ridge Gaseous Diffusion Plant (ORGDP) is based on the premise that groundwater geochemistry reflects the chemical composition of, and geochemical processes active in, the strata from which the sample is obtained. Potential uranium-bearing areas can be identified at virtually any scale, depending on sample spacing and availability of groundwater samples from the strata of interest. In south Texas, for example, work by the ORGDP has shown that groundwater exhibits zonation related to known mineralization for uranium, vanadium, arsenic, molybdenum, sulfate, selenium, barium, and conductivity. A degree of zonation for these elements is present at both the regional and local scale. Personnel of the Uranium Resource Evaluation Project of ORGDP collect samples in pilot surveys, as well as in 2 reconnaissance phases, with groundwater samples collected in each phase. Experience from 8 pilot surveys conducted throughout the ORGDP area of responsibility has shown that wells are the best source of groundwater, although, on occasion, springs are sampled as part of the program. (Sims-ISWS)
W79-05521

HYDROGEOCHEMICAL AND STREAM SEDIMENT RECONNAISSANCE OF THE NATIONAL URANIUM RESOURCE EVALUATION PROGRAM, OCTOBER-DECEMBER 1976,
Los Alamos Scientific Lab., NM.
P. L. Aamodt, J. M. Hansel, Jr., M. M. Minor, and R. J. Beckman.
Available from the National Technical Information Service, Springfield, VA 22161 as GJBX 20-77, Price codes: A03 in paper copy, A01 in microfiche. Report LA-6708-PR, February 1977. 27 p, 11 fig, 3 tab. ERDA W-7405-ENG-36.

Descriptors: *New Mexico, *Montana, *Colorado, *Wyoming, *Water chemistry, *Sediments, *Uranium, *Sampling, Instrumentation, Data collections, Chemical analysis, X-ray fluorescence, Spectroscopy, Chemicals, Surveys, Computer programs, Analytical techniques, Water quality, On-site investigations.

Field sampling in New Mexico was limited this quarter to the collection of water and/or sediment samples from 4,000 locations in two 20,000-sq km areas in the southeastern corner of the state. Approximately 1,100 locations were sampled in Montana and Colorado as parts of pilot studies in those states, and 100 locations were sampled by a commercial contractor in south-central Wyoming. Several thousand samples were inventoried and sent to the analytical laboratories for analysis. A major effort has gone into the preparation of reports for open filing next quarter, including reports on pilot and orientation studies, reconnaissance sampling, and topical subjects. Uranium analysis of waters by

fluorimetry continued at an average rate of 850 analyses per week throughout the quarter. Multi-element analysis capability using x-ray fluorescence and spectro-chemical methods continued to be improved to increase both sample throughput and analytical precision. Modifications to the reactor transport system have lowered the effective uranium detection limit for 40-ml water samples to 0.25 ppt. The pneumatic transfer system also has been expanded to allow rapid multi-element analyses of sediment samples. Not all of the detectors have been installed to complete this system, but they will be in the next few months. Sediment samples have been analyzed for uranium at an average rate of 1,000 per week during this quarter. Several new computer programs have been developed to improve both the management and statistical treatment of National Uranium Resource Evaluation-Hydrogeochemical and Stream Sediment Reconnaissance data. (Sims-ISWS)
W79-05522

NITRATES AND BACTERIAL DISTRIBUTION IN RURAL DOMESTIC WATER SUPPLIES,
Texas Univ. Health Science Center at Houston. School of Public Health.
For primary bibliographic entry see Field 5B.
W79-05524

SORPTION AND ACCUMULATION OF CADMIUM IN THE SEDIMENT OF THE TAMA RIVER,
Tokyo Univ. (Japan). Inst. of Industrial Science.
M. Suzuki, T. Yamada, T. Miyazaki, and K. Kawazoe.
Water Research, Vol. 13, No. 1, p 57-63, 1979. 8 fig, 3 tab, 8 ref.

Descriptors: *Sorption, *Cadmium, *Sediments, Pollutants, Heavy metals, Sampling, Chemical analysis, Data processing, Rivers, Water pollution, Zinc, Foreign countries, Foreign research, Copper, Adsorption, Organic matter, Laboratory tests, Correlation analysis, *Japan, *Tama River(Japan).

Cadmium contents in the water and the sediment samples collected from the Tama River and several branches were measured. Cadmium (above 0.005 mg/l) was detected in only 4 of the water samples, while the sediment samples showed cadmium content of 1.0-9.8 micro g/g dry sediment. Cadmium concentration in the sediments of the main stream was correlated against ignition loss of the samples, and it was found that 1 g of ignition loss (organic matter) corresponded to 35 micro g of cadmium. The batch adsorption experiment in the laboratory using an aqueous solution of cadmium for 14 sediment samples with a higher concentration of cadmium indicated that the amount adsorbed by the sediment is highly dependent on the ignition loss. The amount adsorbed on unit mass of ignition loss could be correlated by a Freundlich-type equilibrium relation. The adsorption rate measurement showed that the intraparticle diffusion coefficient of cadmium in the sediment was about 0.000011 sq cm/s, which is of a reasonable order of magnitude assuming the pore diffusion mechanism inside the particle. The results suggested that suspended solid particles of high organic content in flowing water contribute significantly to the transport of cadmium along the river. (Sims-ISWS)
W79-05525

GEOLOGIC AND GEOPHYSICAL DATA FROM OSCEOLA NATIONAL FOREST, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. A. Miller.
Geological Survey open-file report 78-799, October 1978. 101 p, 1 fig, 2 tab, 2 ref.

Descriptors: *Lithologic logs, *Radioactive well logging, *Marine microorganisms, *Hydrogeology, *Stratigraphy, Sedimentary rocks, Geologic units, Phosphates, Mining, Environmental effects, Projections, *Florida, *Osceola National Forest(FL), Ocala Limestone, Hawthorn Formation, Post-miocene deposits.

Identification Of Pollutants—Group 5A

Ten core holes were drilled as part of a hydrologic study of Osceola National Forest. This report describes the detailed lithology of the cores taken from test drilling, illustrates gamma-ray logs obtained from the test holes and from wells near the forest, and lists the microfauna obtained and identified from the cores. (Woodard-USGS)
W79-05605

GRANULAR MEDIA FILTRATION OF DREDGING EFFLUENTS,

Northwestern Univ. Evanston, IL. Dept. of Civil Engineering.
D. K. Atmatzidis, J. A. FitzPatrick, and R. J. Krizek.

Journal of the Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers, Vol. 105, No. WW1, Proceedings Paper 14342, p 33-50, February 1979. 4 fig, 5 tab, 18 ref. DACW 39-74-C-0090.

Descriptors: *Dredging, *Effluents, *Filtration, Sands, Gravels, Granules, Spoil banks, Waste disposal, Filters, *Dredged material, Granular media filtration, Diked disposal area, Filter systems, Clay suspensions.

The consideration of a dredged material confinement facility as a solid-liquid separation system requires the use of filter systems for clarifying disposal area effluents. The following data were presented: (1) the types of tests that were performed; (2) the rationale for selecting the range of values for the parameters; (3) the methods and techniques for conducting the tests and collecting the data; and (4) an analysis and review of the results. Conclusions were reported regarding the characteristics and performance capabilities of sands or gravels and anthracites as media for non-mechanized, deep-bed, filtration systems. In general, sands and anthracites with effective grain smaller than 2.0 mm and 3.5 mm and larger than 0.4 mm and 0.8 mm, respectively, are strong candidates for use in disposal area filter systems. (Roberts-ISWS)
W79-05621

ACID PRECIPITATION IN THE NEW YORK METROPOLITAN AREA: ITS RELATIONSHIP TO METEOROLOGICAL FACTORS,
Interstate Sanitation Commission, New York.
For primary bibliographic entry see Field 2K.
W79-05626

SOURCES AND FATES OF AROMATIC COMPOUNDS IN URBAN STORMWATER RUNOFF,
Environmental Protection Agency, Edison, NJ. Surveillance and Analysis Div.
M. J. MacKenzie, and J. V. Hunter.
Environmental Science and Technology, Vol. 13, No. 2, p 179-183, February 1979. 5 fig, 2 tab, 13 ref. NSF ENV74-14810B.

Descriptors: *Aromatic compounds, *Oil, *Storm runoff, *Sediments, Chemicals, Chemical analysis, Chromatography, Sampling, Organic compounds, Pollutants, Water pollution, Water pollution sources, Path of pollutants, Analytical techniques, Dibenzothiophene, Crankcase oil.

Petroleum-derived aromatic hydrocarbons and associated sulfur compounds in urban stormwater runoff and Delaware River sediment samples were characterized using a gas chromatograph equipped with a flame ionization/sulfur specific flame photometric detector system. Total petroleum hydrocarbon concentrations were determined gravimetrically in stormwater emanating from a northern Philadelphia storm sewer. Comparison of hydrocarbon and sulfur fingerprints of the aromatic fractions of environmental samples to reference oils indicated that crankcase oil was the most likely source of aromatics in stormwater runoff. A weathering study on used crankcase oil showed a loss of diaromatics accounting for their absence in the environmental samples. A method of transport by which land-based oil enters the aquatic environment and receiving water sediments was proposed. Dibenzothiophene was identified in the environ-

mental samples by retention time and mass spectrometry. Concentrations of dibenzothiophene in stormwater runoff ranged from 44.2 to 62.3 ng/L. (Sims-ISWS)
W79-05627

NITROGEN AND CHLORIDE MOVEMENT IN SMALL UPLAND PIEDMONT WATERSHEDS: I. NITRATE-NITROGEN AND CHLORIDE DISTRIBUTION IN SOIL PROFILES,

Southern Piedmont Conservation Research Center, Walkinsville, GA.

For primary bibliographic entry see Field 5B.
W79-05641

NITROGEN AND CHLORIDE MOVEMENT IN SMALL UPLAND PIEDMONT WATERSHEDS: II. NITROGEN AND CHLORIDE TRANSPORT IN RUNOFF,

Southern Piedmont Conservation Research Center, Walkinsville, GA.

For primary bibliographic entry see Field 5B.
W79-05642

NITRATE MOVEMENT IN A CHILEAN AGRICULTURAL AREA IRRIGATED WITH UNTREATED SEWAGE WATER,

Chile Univ., Santiago. Dept. of Inorganic and Analytical Chemistry.

For primary bibliographic entry see Field 5B.
W79-05643

HEALTH HAZARDS FROM DRINKING WATER,

World Health Organization, Copenhagen (Denmark). Regional Office for Europe.

Working Group Report, 26-30 September 1977. 13 p.

Descriptors: *Potable water, *Lead, *Nitrates, *Water pollution effects, *Public health, *Water quality standards, Poisons, Toxicity, Human diseases, Pollutants, Heavy metals, Metal pipes, Nitrates, Nitrosamines, World Health Organization, International cooperation, Water pollution control, Water supply.

The World Health Organization's working group on health hazards from drinking water (European Region) met in September 1977 to consider: (1) the concept of 'health hazard'; (2) health effects from increased lead levels in water, and (3) health risks from nitrate concentrations in water. The working group, composed of medical and technical experts from 11 countries, recommended that for lead: (1) the upper limit in running water should be 0.05 mg/l; (2) when lead pipes are present, lead content should not exceed 0.05 mg/l in a sample taken at the tap after flushing, and levels frequently or notably exceeding 0.1 mg/l should be reduced; and (3) when lead is present, water from domestic water softeners and hot-water systems should not be drunk. For nitrate: (1) nitrate NO3 level below 50 mg/l is acceptable for the general population, 50-100 mg/l is borderline, and over 100 mg/l is unacceptable; and (2) for infants under six months of age nitrate levels over 50 mg/l are unacceptable. It was agreed that setting of standards must take into account both analytical limits and technical feasibility. Criteria documents should consist of: (1) summary of issues and research priorities, (2) findings on which health risk evaluation is made, (3) evaluation of health hazard of the agent in question, and (4) appraisal of the significance of the health effect, with an indication of the basis for required safety factors. (Lynch-Wisconsin)
W79-05726

INFLUENCE OF NON-POINT POLLUTION SOURCES IN CONNECTION WITH THE TUY RIVER BASIN SANITATION STUDIES,

Universidad Central de Venezuela, Caracas.

J. R. Hurtado, and G. R. Mijares.
Progress in Water Technology, Vol 10, No 3-4, p 109-118, 1978. 3 fig, 9 tab, 2 ref.

Descriptors: *Tuy River Basin (Venezuela), *Non-point pollution, *Agricultural runoff, *Soil erosion, *Sewage disposal, *Water pollution sources, *Water treatment, Venezuela, Caracas (Venezuela), Rivers, River basins, Water pollution effects, Coliforms, Biochemical oxygen demand, Land use, Farm management, Water management, Water pollution control, Water quality standards, Streamflow, Dissolved solids, Seasonal, Planning, Point pollution.

Water pollution was studied in the Tuy River Basin of north-central Venezuela, an important source of water for the Caracas metropolitan area, to: (1) identify and measure water pollution sources from El Consejo to Pumping Station No. 1, (2) determine effects of pollution on water quality, (3) establish criteria for water at Pumping Station No. 1, and (4) determine if treatment of point sources of pollution is sufficient to meet criteria for Pumping Station No. 1 and to provide a safe source of water for Caracas after conventional treatment. Conclusions: (1) the River Tuy carries a flow composed of river water and untreated sewage discharged by Caracas; (2) for a safe water supply point sources must be treated and nonpoint sources, major contributors of coliforms and BOD, must be treated or eliminated; (3) major coliform inputs occur during both wet and dry seasons, especially as a result of topsoil erosion from farmland; (4) significant sources of BOD exist all along the river during the wet season, likewise attributable to agricultural activities; and (5) in most cases, the only practical management option is prevention rather than cure, including land-use management in the case of nonpoint pollution control. To provide rational management of the water resources of the mid-Tuy Basin, a river authority should be established which would begin by developing a comprehensive plan for watershed management. (Lynch-Wisconsin)
W79-05740

SURFACE WATER QUALITY ASSOCIATED WITH THE SURFACE MINING OF IOWA COAL,

Iowa State Univ., Ames. Energy and Mineral Resources Research Inst.

For primary bibliographic entry see Field 5B.
W79-05834

PARAMETER ESTIMATION OF STREETER-PHELPS MODELS,

Politecnico di Milano, Milan (Italy).

For primary bibliographic entry see Field 5B.
W79-05841

MONITORING AREA-WIDE RURAL WATER QUALITY,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.

L. F. Bliven, F. J. Humenik, F. A. Koehler, and M. R. Overcash.

Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol. 105, No. EE1, Proceedings Paper 14343, p 101-112, February 1979. 1 fig, 4 tab, 10 ref, 2 append. EPA R803328.

Descriptors: *Water quality, *Agricultural watersheds, *Monitoring, *Sampling, Streams, Rivers, Water pollution, Water pollution sources, Statistical analysis, Chemical analysis, Runoff, Rainfall, Water yield, Watersheds (Basins), Water chemistry, Pollutants, Oxygen, Nitrogen compounds, Hydrology, Sampling techniques.

Stream water quality is usually measured by either grab or automated sampling schemes. Data obtained by these two methods at identical locations on rural watersheds demonstrated that sampling techniques themselves impacted measured water quality values. Point-in-time comparisons indicated that COD and TOC concentrations were lower grab than automated samples due to sample procurement and storage effects. A first sample effect also was demonstrated for COD, TOC, TP, and TKN concentrations by analysis of sequential samples obtained with automated samplers employing

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Group 5A—Identification Of Pollutants

a sample-flush operational mode. The areawide annual water yield estimate obtained by simple time stratified grab sampling was approximately equal to the historical average, but the precision of individual site estimates was low because the distributions of flow measurements at the sites were highly skewed. Therefore, the potential of daily rainfall predictions as a stratification method to provide increased annual water yield precision at a given sampling frequency or budget level was demonstrated. (Sims-ISWS)
W79-05842

THE OCCURRENCE OF ORGANOCHLORINE RESIDUES IN RAINWATER,
Freshwater Fisheries Lab., Pitlochry (Scotland).
D. E. Wells, and S. J. Johnstone.
Water, Air, and Soil Pollution, Vol. 9, No. 3, p 271-280, April 1978. 2 fig, 5 tab, 19 ref.

Descriptors: *Pollutant identification, *Water pollution sources, *Rain water, *Polychlorinated biphenyls, Air pollution, Sampling, Analytical techniques, Methodology, Laboratory tests, Pollutants, On-site investigations, DDT, Pesticide residues, Foreign research, DDE, Dieldrin, DDD, Aroclors, *United Kingdom, Organochlorine residues.

A method for the extraction of organochlorine (OC) residues from rainwater was developed using coated polyurethane foam. The efficiency of the extraction procedure was tested at low concentrations (sub-ng/l), and the effects of flow rate, pH, suspended particulates, and the volume of water analyzed were determined. The coated foam plugs were incorporated into 8 sampling units stationed along the eastern coastline of the United Kingdom to monitor the atmospheric deposition of organochlorines. The results obtained were used to predict the annual contribution of OCs from the British mainland deposited into the North Sea. There was a gradation from north to south in the atmospheric contribution of OCs to the North Sea from a westerly direction, and with the data available at present (1978), it was possible to arrive at an approximate estimate of the aerial input. The area of the North Sea is 575,000 sq km, and the mean annual input for the 4 groups of organochlorines analyzed is 1.91 tons for PCBs, 1.43 tons for total DDT, 2.08 tons for total-HCH, and 0.27 tons for dieldrin. (Humphreys-ISWS)
W79-05848

TRACE METAL TRANSPORT FROM MINING, MILLING, AND SMELTING WATERSHEDS,
Syracuse Univ., NY.
For primary bibliographic entry see Field 5B.
W79-05858

METABOLISM OF NITROPHENOLS IN FLOODED SOILS,
Central Rice Research Inst., Cuttack (India). Lab. of Soil Microbiology.
B. Sudhakar, and N. Sethunathan.
Journal of Environmental Quality, Vol. 7, No. 3, p 349-352, July-September, 1978. 4 tab, 12 ref.

Descriptors: Organophosphorus compounds, *Flooding, Nitrites, Isotope studies, *Parathion, *Hydrolysis.

Nitrophenols (p-, o-, and m-isomers and 2,4-dinitrophenol) disappeared fairly rapidly from flooded alluvial and organic-matter-rich acid sulfate (pokkali) soils inoculated with parathion (O,O-diethyl O,p-nitrophenyl phosphorothioate)-enrichment cultures from the respective soils. Nitrate, one of the reported end-products of nitrophenol (O,O-dimethyl O,p-nitrophenyl phosphorothioate) metabolism, accumulated only in inoculated alluvial soil, irrespective of the type of nitrophenol added. In an isotope study, ring cleavage of p-nitrophenol leading to carbon dioxide was demonstrated in flooded soils inoculated with parathion-enrichment culture, particularly under stirred conditions. Nitrophenols decomposed also in uninoculated samples of both soil types, though slowly as compared to inoculated soils; but nitrate and carbon dioxide were not formed. Resting cells of a bacterium,

Pseudomonas sp. ATCC 29353, readily hydrolyzed parathion and then liberated nitrite from p-nitrophenol. In cell-free suspension, the reaction ceased at the p-nitrophenol stage. In bacterial cultures, parathion was hydrolyzed without proliferation while subsequent degradation of p-nitrophenol involved metabolism leading to bacterial enrichment. (Skogerboe-Colorado State)
W79-05936

5B. Sources Of Pollution

NITRATES AND BACTERIAL DISTRIBUTION IN RURAL DOMESTIC WATER SUPPLIES,
Texas Univ. Health Science Center at Houston. School of Public Health.
D. Brooks, and I. Coch.
Water Research, Vol. 13, No. 1, p 33-41, 1979. 5 fig, 1 tab, 24 ref. NIH IA04AHZ12201.

Descriptors: *Water quality, *Bacteria, *Nitrates, *Texas, Sampling, Wells, Water wells, Rural areas, Water pollution, Water pollution sources, Domestic water, Pollutants, Coliforms, Streptococcus, Nitrogen compounds, Farm wastes, Septic tanks, Data processing, *Houston County(TX).

The protection of underground water resources is an important facet of the Safe Drinking Water Act. Effective intervention strategy for active source protection requires up-to-date information on groundwater quality and the knowledge of potential sources and causes of contamination. In the present study, the state of well water supplies in rural East Texas was evaluated in order to develop a practical approach to surveying water sources in "back-country" areas, which would allow the differentiation of natural from anthropogenic factors affecting water quality. The specific focus was on nitrates, their extent, causes, and sources in rural well water. Data were processed using synoptic mapping which permitted the comparison of the natural tendency in distribution of nitrates with the patterns induced by man's activities. Trend surface analysis of data indicated that the surveyed Tertiary and Quaternary sands were not naturally nitrate-rich. Localized and well-defined spots of nitrates, many times in excess of the background, were traceable to the anthropogenic sources. The study identified the characteristics of high risk wells. (Sims-ISWS)
W79-05524

SORPTION AND ACCUMULATION OF CADMIUM IN THE SEDIMENT OF THE TAMA RIVER,
Tokyo Univ. (Japan). Inst. of Industrial Science.
For primary bibliographic entry see Field 5A.
W79-05525

TWO-DIMENSIONAL BUBBLE PLUMES,
New South Wales Univ., Kensington (Australia). Water Research Lab.
For primary bibliographic entry see Field 8B.
W79-05539

GEOHYDROLOGICAL RESEARCH AT THE CHALMERS UNIVERSITY OF TECHNOLOGY, GÖTEBORG.
For primary bibliographic entry see Field 4C.
W79-05546

SOME ASPECTS ON URBAN RUNOFF QUALITY MODELING,
Chalmers Univ. of Technology, Göteborg (Sweden). Dept. of Water Supply and Sewerage.
G. Svensson.

Descriptors: *Urban runoff, *Water quality, *Model studies, Mathematical models, Water pollution, Water pollution sources, Storm runoff, Pollutants, Suspended solids, Path of pollutants, Surface runoff, Cities, Urban hydrology, *Sweden.

At Chalmers University of Technology, urban runoff quantity and quality have been subject to

investigation since 1970. These investigations have increased knowledge of the composition of urban storm water and the quality variations. Attempts to correlate the constituent concentrations to runoff intensity, runoff duration, or time to antecedent rainfall have not succeeded very well. Although there is some correlation between the concentrations and these factors, no simple equations can be given. Therefore, the research has been concentrated on the question of what causes storm water pollution. During the last year, an investigation has been carried out aimed at quantifying the sources of storm water pollutants. (See also W79-05546) (Sims-ISWS)
W79-05549

NONPOINT SOURCE POLLUTION,
Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.
W. Whipple, Jr.
Preprint 3461, American Society of Civil Engineers, for ASCE Convention and Exposition, Boston, Mass., April 2-6, 1979. 16 p, 22 ref. OWRT A-025-N.J.(12), B-063-N.J.(3), (B-059-N.J.) (3), 14-31-0001-3830, 14-34-0001-7124.

Descriptors: *Federal Water Pollution Control Act, Management, *Planning, *Water pollution effects, Heavy metals, Institutions, Biochemical oxygen demand, Nutrients, *Water pollution sources, *Nonpoint pollution, Hydrocarbons.

The control of pollution from urban runoff and other nonpoint sources will be necessary if water quality objectives are to be reached. In fact, in urbanizing areas, it will be necessary to avoid further degradation of stream quality. Realistically, where no Federal funding is available, and no Federal coercive power is practicable to exert, programs of this nature can only be adopted to the extent that the proposed program is clearly related to an objective of local concern. Unfortunately, the accurate estimation of nonpoint source pollution is difficult and time consuming, and, for this reason, the initial phase of 208 planning did not generally succeed in characterizing runoff pollution and the nature of the problems in the various waterways. Therefore, more efficient and economical programs to do this must be devised, which may start with streamwalking and surveillance. Remedial management programs to be funded must be cost effective, and must consider aspects of flooding, erosion, and water supply as well as water quality. Means adopted may include detention requirements placed upon developers in the joint interest of flood retardation and water quality. A great deal more research and data gathering would be desirable to develop better technology and conduct detailed planning; but so far the issue has only moderately impressed Federal authorities. If the urgent situations arising in lakes and streams are to be handled successfully, supplementary local funding and good engineering judgment are going to be necessary.
W79-05582

WATER-SUPPLY POTENTIAL OF THE LOWER HILLSBOROUGH RIVER, FLORIDA, 1976,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4A.
W79-05586

MONTHLY FLUCTUATIONS IN THE QUALITY OF GROUND WATER NEAR THE WATER TABLE IN NASSAU AND SUFFOLK COUNTIES, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
B. G. Katz, S. E. Ragone, and J. B. Lindner.
Geological Survey Water-Resources Investigations 78-41, 1978. 38 p, 10 fig, 4 tab, 38 ref.

Descriptors: *Water quality, *Groundwater, *Water pollution sources, *Septic tanks, *Storm runoff, Fertilizers, Precipitation (Atmospheric), Nitrates, Chlorides, Sulfates, New York, *Long

Sources Of Pollution—Group 5B

LOSS RATES OF SUSPENDED MATERIAL SEDIMENTED IN A MARINE BAY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
For primary bibliographic entry see Field 2L.
W79-05639

ORIGIN OF DEPOSITED MATERIAL SEDIMENTED IN A MARINE BAY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
For primary bibliographic entry see Field 2L.
W79-05640

NITROGEN AND CHLORIDE MOVEMENT IN SMALL UPLAND PIEDMONT WATERSHEDS: I. NITRATE-NITROGEN AND CHLORIDE DISTRIBUTION IN SOIL PROFILES,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
G. W. Langdale, R. A. Leonard, W. G. Fleming, and W. A. Jackson.
Journal of Environmental Quality, Vol. 8, No. 1, p 49-57, January-March 1979. 6 fig, 4 tab, 16 ref.

Descriptors: *Nitrogen, *Chlorides, *Soil profiles, Fertilizers, Soil water, Groundwater, Watersheds(Basins), Crops, Sampling, Chemicals analysis, Rainfall, Runoff, Storm runoff, Soil texture, Nitrates, Nutrients, Water pollution, Pollutants, Water pollution sources, Agricultural watersheds, Agriculture, Nonpoint water pollution sources.

Soil profile characteristics of many soils are related to the partitioning of fertilizers for soil pool, plant uptake, overland transport, and deep seepage. Chloride and NO₃-N distribution patterns were studied on variable soil profiles of two small agricultural watersheds planted to corn. Management variables included grazed waterways, graded terraces, and winter rye cover crops. Landscape slope and soil characteristics of the surface and contour section layers were inherent variables within and among watersheds. Average soil Cl concentrations decreased from 275 ppm to background levels (30 ppm) at the 0- to 8-cm soil depth within 40 days after spring-incorporated applications of Cl fertilizer (112 kg Cl/ha as KCl). Nitrogen fertilizers (about 140 kg N/ha per year) were applied in split applications to meet optimum corn-growth demands. Average NO₃-N concentrations ranged from 20 to 40 ppm at the 0- to 8-cm depth immediately after N-fertilizer applications, but decreased rapidly because of biological assimilation. (See also W79-05642) (Sims-ISWS)
W79-05641

NITROGEN AND CHLORIDE MOVEMENT IN SMALL UPLAND PIEDMONT WATERSHEDS: II. NITROGEN AND CHLORIDE TRANSPORT IN RUNOFF,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
G. W. Langdale, R. A. Leonard, W. G. Fleming, and W. A. Jackson.
Journal of Environmental Quality, Vol. 8, No. 1, p 57-63, January-March 1979. 2 fig, 6 tab, 16 ref.

Descriptors: *Nitrogen, *Chlorides, *Runoff, Fertilizers, Watersheds(Basins), Agricultural watersheds, Sampling, Chemical analysis, Rainfall, Nutrients, Sediments, Pollutants, Water pollution, Water pollution sources, Agriculture, Hydrology, Nonpoint water pollution sources.

Selective management practices were used on two upland Southern Piedmont watersheds to assess their influence on overland transport of Cl, soluble-N, and total Kjeldahl-N (TKN). Ammonia-N and TKN were measured in both runoff water and sediment phases and related to these transport modes. Chloride (112 kg Cl/ha) served as a tracer anion because of its inert biological activity. Optimum rates of N-fertilizer (about 140 kg N/ha) were applied in recommended split-applications for corn growth. Annual NH₄-N and TKN losses were 35 to 40% less when associated with terraces and double cropping of corn and winter rye than

Tracking techniques, Pumped storage, Planning, New York.

Data were collected during a dye-dispersion study on a 6-mile, tide-affected reach of the Hudson River near the proposed Cornwall Pumped Storage Project on September 21-22, 1977. The results indicated that complete mixing did not occur during the first tidal cycle but was complete after two or more cycles. The fluorometric dye-tracing procedure was used to determine the dispersion characteristics of the water mass. Rhodamine WT dye, 20-percent solution, was continuously injected on the west side of the river throughout an ebb tide, and its movement was monitored during a 30-hour period. Samples were collected both individually and continuously. Automatic dye samplers were used at selected cross sections near each bank. Bathymetric measurements were made at eight cross sections between Newburgh and West Point to determine the depths. (Woodard-USGS)
W79-05596

RECORD OF WELLS IN THE FLORIDAN AQUIFER IN DADE AND MONROE COUNTIES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W79-05606

SEASONAL CYCLING OF CESIUM-137 IN A RESERVOIR,
Savannah River Ecology Lab., Aiken, SC.
J. J. Alberts, L. J. Tilly, and T. J. Vigerstad.
Science, Vol. 203, No. 4381, p 649-651, February 16, 1979. 4 fig, 16 ref. Dept. of Energy EY-76-C-09-0819, AT(07)-2-1.

Descriptors: *Cesium, *Reservoirs, *Sediments, *Variability, Seasonal, Cooling water, Radioisotopes, Nuclear wastes, Pollutants, Water pollution, Path of pollutants, Sampling, On-site investigations, Seasonal cycling, Cesium-137.

Studies of a reservoir in the southeastern United States showed that cesium-137, introduced into the system from a leak in a nuclear fuel element, cycles between the water and sediment on a seasonal basis. The cycling, which coincides with the annual periods of thermal stratification in this monomictic lake, has been occurring for over 10 years. (Sims-ISWS)
W79-05622

DISTRIBUTION OF SUSPENDED BACTERIA IN THE NEWPORT RIVER ESTUARY, NORTH CAROLINA,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
For primary bibliographic entry see Field 2L.
W79-05623

ACID PRECIPITATION IN THE NEW YORK METROPOLITAN AREA: ITS RELATIONSHIP TO METEOROLOGICAL FACTORS,
Interstate Sanitation Commission, New York.
For primary bibliographic entry see Field 2K.
W79-05626

SOURCES AND FATES OF AROMATIC COMPOUNDS IN URBAN STORMWATER RUNOFF,
Environmental Protection Agency, Edison, NJ. Surveillance and Analysis Div.
For primary bibliographic entry see Field 5A.
W79-05627

SEASONAL CHANGES IN OXYGEN UPTAKE BY SETTLED PARTICULATE MATTER AND SEDIMENTS IN A MARINE BAY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
For primary bibliographic entry see Field 2L.
W79-05638

Island, *Nassau County, *Suffolk County, Deicing salts.

Water samples from wells in a sewered and an unsewered suburban area and an unsewered rural area on Long Island, N.Y. were collected and analyzed monthly from August 1975 to July 1976 to determine the concentrations of chloride, sulfate, and nitrate in ground water near the water table. Short-term and seasonal fluctuations in concentrations of these substances were evaluated to determine their relation to nonpoint discharges. Major factors that may cause concentrations of these substances to fluctuate at any particular site are precipitation, lawn fertilizer, dissolved salts in storm runoff, and effluent from septic tanks and cesspools. Chloride concentrations during the study fluctuated by as little as 2 milligrams per liter (mg/liter) at some sites and as much as 300 mg/liter at others. Nitrate and sulfate concentrations showed essentially no change at some sites but fluctuated by as much as 8 and 40 mg/liter, respectively, at others. Short-term fluctuations in the concentrations of these substances in ground water seem to have no consistent correlation with type of land use (suburban or agricultural) or precipitation but seem to be related to seasonal variations in input from specific nonpoint sources. (Woodard-USGS)
W79-05587

QUALITY OF THE WATER IN BORROW PONDS NEAR A MAJOR HIGHWAY INTERCHANGE, DADE COUNTY, FLORIDA, OCTOBER-NOVEMBER 1977,
Geological Survey, Tallahassee, FL. Water Resources Div.
T. R. Beaven, and B. F. McPherson.
Geological Survey open-file report 78-1029, 1978. 15 p, 3 fig, 7 tab, 8 ref.

Descriptors: *Water quality, *Water pollution sources, *Highway effects, *Surface waters, *Aquatic environment, Ponds, Sampling, Chemical analysis, Water analysis, Bottom sediments, Trace elements, Chromium, Lead, Dieldrin, Iron, Manganese, Zinc, Polychlorinated biphenyls, Phenols, *Florida, *Dade County(FL), *Vehicular pollution, *Borrow Ponds(FL).

Water, bottom sediment, and aquatic plants were sampled from ponds near a major south Florida highway interchange to document concentrations of selected constituents in an aquatic environment near heavy vehicular traffic. Generally, concentrations of constituents were within the range expected in an uncontaminated environment in south Florida. However, concentrations did exceed south Florida background levels or Environmental Protection Agency criteria in a few cases. Two trace elements—chromium (20 micrograms per liter) in ponded surface water and lead (500 micrograms per gram) in bottom sediment—exceeded background levels. Concentrations of dieldrin (22 micrograms per kilogram) and polychlorinated biphenyls (53 micrograms per kilogram) also exceeded background levels in bottom sediment. The concentration of phenol (23 micrograms per liter) in ground water exceeded Environmental Protection Agency quality criteria by 22 micrograms per liter, but was within the background range for south Florida. Ten metals were detected in the cattail or algal samples, but only iron, manganese, and zinc were in higher concentrations than those in the bottom sediment. (Woodard-USGS)
W79-05589

DYE-DISPERSION STUDY AT PROPOSED PUMPED-STORAGE PROJECT ON HUDSON RIVER AT CORNWALL-ON-THE-HUDSON, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
B. Dunn, and G. C. Gravelle, Jr.
Geological Survey open-file report 78-589, July 1978. 40 p, 16 fig, 1 tab, 6 ref.

Descriptors: *Path of pollutants, *Dye dispersion, *Tidal effects, *Mixing, *Hudson River, Estuaries, Baseline studies, Fluorescent dye, Rhodamine,

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

from a watershed without conservation practices. This difference was related primarily to difference in sediment yield from the two watersheds. No real annual differences were detected for Cl and NO₃-N losses between watersheds. Total seasonal nutrient losses were strongly affected by the quantity of sediment transported during highly erosive periods of May, June, and July. (See also W79-05641) (Sims-ISWS) W79-05642

NITRATE MOVEMENT IN A CHILEAN AGRICULTURAL AREA IRRIGATED WITH UNTREATED SEWAGE WATER.
Chile Univ., Santiago. Dept. of Inorganic and Analytical Chemistry.
E. B. Schalscha, I. Vergara, T. Schirado, and M. Morales.
Journal of Environmental Quality, Vol. 8, No. 1, p. 27-30, January-March 1979. 1 fig, 5 tab, 15 ref.

Descriptors: *Irrigation, *Sewage effluents, *Nitrate, *Groundwater, Municipal wastes, Industrial wastes, Leaching, Foreign countries, Travel time, Foreign research, Water quality, Water pollution, Water pollution sources, Pollutants, Nitrogen compounds, On-site investigations, On-site data collections, Crops, Vegetable crops, Public health, Water wells, Agriculture, *Chile.

Nitrate concentrations in soils and drainage and well waters were determined in a 15-ha field representing about 4,000 ha of agricultural land irrigated exclusively with raw sewage water for more than 25 years. Analyses of the percolating water below the root zone indicated that the leached NO₃(-)-N was about 350 kg/ha per year. The transit time for water to move through the unsaturated zone to the saturated zone at a depth of 2 to 2.2 m was less than 1 year, and the leaching fraction was estimated as 0.63. Concentrations of NO₃(-)-N ranged from 20 to 35 mg/liter in the percolating water of the unsaturated zone, whereas two well waters contained 9 and 14 mg/liter. (Sims-ISWS) W79-05643

MAN'S IMPACT ON THE MIDDLE ATLANTIC CONTINENTAL SHELF AND THE NEW YORK BIGHT—SYMPOSIUM SUMMARY.
Johns Hopkins Univ., Baltimore, MD. Chesapeake Bay Inst.
M. G. Gross, R. L. Swanson, and H. M. Stanford.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.). American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p. 1-13, 1976. 2 fig, 1 tab, 55 ref. Allen Press, Inc., Lawrence, Kansas.

Descriptors: *Resources development, *Water pollution sources, *Water pollution effects, *Baseline studies, *Environmental effects, Oil pollution, Polychlorinated biphenyls, Sewage sludge, Waste disposal, Sediment transport, Bottom sediments, Public health, *Outer Continental Shelf, *Ocean dumping, *New York Bight.

Human activities in coastal ocean areas are causing ever-increasing concern, especially near urban regions. Serious questions have been raised about the impact on this coastal ecosystem of releasing wastes and contaminants, siting power plants, and drilling for oil on the continental shelf. The symposium considered the environmental quality of the middle Atlantic continental shelf and New York Bight and assessed man's impact on this continental shelf ecosystem. Particular attention was given to applications of research results to questions of public policy and resource allocation in addressing man-related environmental changes. These results are summarized and an attempt is made to place them in a regional and national perspective. (Sinha-OEIS) W79-05679

PHYSICAL OCEANOGRAPHY OF THE MIDDLE ATLANTIC BIGHT.
Woods Hole Oceanographic Institution, MA.;

Johns Hopkins Univ., Baltimore, MD. Chesapeake Bay Inst.; and National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.
For primary bibliographic entry see Field 2J.
W79-05680

OCEAN-ATMOSPHERE INTERACTIONS OFF THE NORTHEAST COAST OF NORTH AMERICA.
National Marine Fisheries Service, Seattle, WA. Northwest Fisheries Center.
T. Lavett, J. Harding, K. Rabe, and S. Larson.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.). American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p. 35-43, 1976. 12 fig, 11 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Baseline studies, *Air pollution effects, *Water pollution sources, Air-water interfaces, Water quality, *Outer Continental Shelf, *New York Bight, Ocean-atmosphere, Sea-air interaction, United States Northeast coast.

The New York Bight-middle Atlantic continental shelf region is typical of midlatitude continental east coast areas in the intense sea-air interaction occurring during late autumn and winter. During these seasons dry but cool air moving over warm coastal water takes up a considerable amount of heat and moisture (latent heat). The daily uptake near the coast can exceed 0.5 g of water per sq cm on a monthly mean basis. The response of the surface layers of the atmosphere to the properties of the sea surface is relatively rapid so that quasi-equilibrium conditions are established after surface air has traveled about 6 h over water. The main consequences of this large heat and moisture uptake on the atmosphere are deepening of lows that pass the coastline and frequent cyclogenesis off the coast. As the heat and moisture are transported upward, a trough forms at the 850-mb level. A thermally driven cyclonic surface wind component is created along the coast, but it often escapes the attention of synoptic weather analysis. The main effect of the atmosphere on the ocean is rapid cooling of already cool coastal waters during autumn and winter, resulting in increases in thermocline depth. The coastal southerly current is influenced by the surface cyclonic wind component. (Sinha-OEIS) W79-05681

NEW YORK BIGHT WATER STRATIFICATION—OCTOBER 1974.
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 1A.
W79-05682

DISTRIBUTION OF HYDROGRAPHIC PROPERTIES IN THE NEW YORK BIGHT APEX.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 1A.
W79-05683

SURFICIAL SEDIMENTS OF THE NOA-MESA STUDY AREAS IN THE NEW YORK BIGHT.
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.; and Adelphi Univ., Garden City, NY.
G. L. Freeland, D. J. P. Swift, W. L. Stubblefield, and A. E. Cok.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.). American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p. 90-101, 1976. 13 fig, 2 tab, 36 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Spoil banks, *Water pollution, Sediments, Sewage sludge, *Outer Continental Shelf, *New York Bight, *Ocean dumping, Surficial sediments, Dredged material.

In the New York Bight apex, extensive sedimentological studies and a 1973 bathymetric survey reveal that the only significant change in bottom topography since 1936 occurred at the dredge spoil dumpsite where the sumping of dredged material has caused up to 10 m shoaling. The center of the Christiansen Basin, a natural collecting area for fine-grained sediment, is no doubt contaminated with sludge but shows no apparent sediment buildup during the intervening 37 years. The apex outside of the Christiansen Basin is floored primarily by sand ranging from silty fine to coarse, with small areas of sandy gravel, artifact (anthropogenic) gravel, and mud. Nearshore mud patches appear to be covered at times with sand and occasionally scoured out. Sidescan sonar records show linear bedforms, indicative of sand movement, over most of the apex area. Two midshelf areas have been proposed as interim alternative dumping areas. The northern area is in a tributary valley of the ancestral Long Island river system. Fine sands cover the northeast part and medium sands predominate to the west and south. Bottom photographs show a smooth, slightly undulatory, mounded or rippled sea floor. In the southern alternative dumping area coarse sand and gravel deposits lie on the crest and east flank of the Hudson divide, while medium and fine sand occurs in the ridge and swale topography to the west. These distributions suggest fine sediment is winnowed from the crest and east flank of the divide and deposited to the west. Veatch and Smith Trough contains a veneer of shelly, pebble sand with large, angular clay pebbles and occasional oyster shells derived from exposed early Holocene lagoonal clay. These studies suggest that if sewage sludge were dumped, widespread dispersion, mostly to the southwest, could be expected, with winter resuspension and transport of fine material on the bottom. Possible permanent buildup on the bottom could be expected if dredged material were dumped. (Sinha-OEIS) W79-05685

DEVELOPMENTAL TESTS ON THE USE OF FLUORESCENT TRACERS AND BACKWASH SEDIMENT-LOAD SAMPLERS TO MEASURE THE BEACH DRIFT COMPONENT OF LITTORAL TRANSPORT AT SANDY HOOK, NEW JERSEY.
Teachers Coll., New York. Dept. of Science Education.
For primary bibliographic entry see Field 2J.
W79-05688

SOURCES OF URBAN WASTES.
Johns Hopkins Univ., Baltimore, MD. Chesapeake Bay Inst.
M. G. Gross.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.). American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p. 150-161, 1976. 4 fig, 7 tab, 39 ref. Allen Press Inc., Lawrence, Kansas. Also as: Chesapeake Bay Contribution 227.

Descriptors: *Water pollution sources, *Water pollution effects, *Waste disposal, Environmental effects, Sediment transport, *Outer Continental Shelf, *New York Bight, *Ocean dumping.

The coastal ocean has long been used by cities along the Middle Atlantic Bight—particularly in the New York-New Jersey metropolitan region—to dispose of municipal, industrial, and dredged wastes; the volumes increased by more than 3% per year in the early 1970s. Sediment eroded from agricultural land and from construction sites must be dredged from navigation channels after deposition by rivers. Solids from sewage (treated and untreated) mix with the riverborne sediments so that large volumes of dredged materials must be handled as wastes. Riverborne sediment load and

Sources Of Pollution—Group 5B

litoral drift must be dredged from navigation channels; that material is now dumped at sea. Industrial wastes, such as from titanium dioxide production and coal ash, have been dumped at sea. Others, such as steel-making slag, have been used for landfill. Construction and demolition debris have been dumped at sea when no landfill sites were available. Refuse, garbage, and incinerator ash are commonly disposed of in coastal wetlands. Alternatives disposal strategies and sites will be needed to supplement present regulations to reduce the urban wastes now dumped at sea. (Sinha-OEIS) W79-05689

CONTAMINANTS ENTERING THE NEW YORK BIGHT: SOURCES, MASS LOADS, SIGNIFICANCE

Manhattan Coll., Bronx, NY. Dept. of Environmental Engineering and Science.
J. A. Mueller, A. R. Anderson, and J. S. Jeris.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 162-170, 1976. 10 fig, 5 tab, 4 ref. Allen Press Inc., Lawrence, Kansas. NOAA-MESA-04-4-002-35.

Descriptors: *Water pollution sources, *Waste disposal, *Wastewater disposal, Urban runoff, Heavy metals, Cadmium, Lead, *Outer Continental Shelf, *New York Bight, *Ocean dumping, Dredge spoil.

Major contaminant inputs to the New York Bight originate from the New York metropolitan area and the Hudson River drainage basin, principally from wastewater, runoff, and barged discharges. Major sources of the microbial load are unchlorinated municipal wastewater discharges and urban runoff. Sewage sludge barge dumps constitute an insignificant microbial load on bight waters. The seasonal variability of municipal wastewater and gauged runoff and annual variability of barge discharges range from a maximum of 1.5-2.0 to a minimum of 0.5-0.7 times the average mass loads. Between 1960 and 1975 the sludge volume as well as fraction digested shows a definite increasing trend. Few data are available on atmospheric and urban runoff inputs. The mass loads reaching the bight are highly related. Poor quality of the dredged materials is caused by contaminants settling from poorly treated wastewater and urban runoff. Increasing levels of wastewater treatment produce more municipal and industrial sludge for disposal. For conservative substances, such as heavy metals, various control measures may redistribute the load among the sources but cause no net decrease in the total. (Sinha-OEIS) W79-05690

TRACE METALS IN THE NEW YORK BIGHT,

National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.

D. A. Segar, and A. Y. Cantillo.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 171-198, 1976. 35 fig, 4 tab, 36 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Water pollution sources, *Waste disposal, *Heavy metals, Environmental effects, Copper, Zinc, Cadmium, *Outer Continental Shelf, *New York Bight, *Ocean dumping, Dredge spoil.

Large quantities of trace metals are introduced to the New York Bight apex from many sources. Distribution of dissolved Mn, Fe, Cd, Cu, and Zn are extremely nonuniform in the waters of the apex due to the many sources and complex reactions taking place. Estuarine discharge and dredge spoil dumping are major sources, while sewage sludge and acid waste dumping are minor sources for most elements studied. Much of the dissolved Cu and Fe occurs in a chemical form that is not

extractable by chelation/solvent extraction, even after acidification. The quantity of this metal fraction increases with distance from the Hudson-Raritan estuary. Loss from solution of some elements, notably Mn, occurs when estuarine water mixes with oceanic water. Metals, particularly Zn, are released to solution during ocean dumping of sewage sludge and other materials. Concentrations of dissolved metals in the apex are higher than on the open shelf and higher in summer than in spring and fall. This suggests that the apex flushes slower in summer, as inputs do not vary significantly with season. Budget calculations show that contaminant metals, exemplified by Cu and Zn, do not accumulate in the apex but are rapidly removed either to the estuaries or the surrounding shelf waters. Mean residence times of contaminant metals in the apex waters are less than 6 months, perhaps considerably less. (Sinha-OEIS) W79-05691

PRELIMINARY ANALYSIS OF THE DISPERSION OF SEWAGE SLUDGE DISCHARGED FROM VESSELS TO NEW YORK BIGHT WATERS,

Corvallis Environmental Research Lab., OR. Marine and Freshwater Ecology Branch.
R. J. Callaway, A. M. Teeter, D. W. Browne, and G. R. Distworth.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 199-211, 1976. 9 fig, 2 tab, 8 ref. Allen Press, Inc., Lawrence, Kansas.

Descriptors: *Water pollution, *Dispersion, Sewage sludge, Waste disposal, *Outer Continental Shelf, *New York Bight, *Ocean dumping.

New York City sewage treatment plant wastes discharged to the New York Bight apex average 2.6% solids. Correlation of extinction coefficient from a 10-cm light-path beam-transmissometer with total suspended matter (TSM) allowed continuous profiling of TSM. STD and beam transmittance profiles were made either by towing the instrument through a sludge patch or wake or by making vertical profiles. Dilution from a near-instantaneous release was on the order of 1,000 within 10 min of release. Dilution in the wake of a release ranged from 500-1000. The time for TSM to reach background or equilibrium values depends on initial concentration. Equilibrium time was approached exponentially for well mixed conditions in about 5.5 h. Pycnocline formation in the upper 8 m caused a similar approach to equilibrium time; below that depth TSM increased slightly with time. TSM from New York Harbor can reach the permit area, but oceanographic conditions in the apex usually prevent this. Relocating the permit area to other deeper areas would cause the affected bottom area to increase in proportion to the increased depth, but concentrations of settled-out material would be inversely proportional, if the oceanographic environment was similar. (Sinha-OEIS) W79-05692

RARITAN BAY AS A SOURCE OF AMMONIUM AND CHLOROPHYLL A FOR THE NEW YORK BIGHT APEX,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.

J. H. Parker, I. W. Duedall, H. B. O'Connors, Jr., and R. Wilson.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 212-219, 1976. 9 fig, 8 ref. Allen Press Inc., Lawrence, Kansas. Also as: SUNY, Marine Sciences Research Center Contribution 169.

Descriptors: *Baseline studies, Chlorophyll a, Ammonium compounds, Nutrients, Ecosystems, Water quality, Water resources, *Outer Continental Shelf, *New York Bight.

Measurements in June 1974 and 1975 in Raritan, Sandy Hook, and Lower New York Bays showed that water nearest Sandy Hook had low salinity and high Chlorophyll a and NH₄⁺ concentrations. Sandy Hook Bay had the highest Chlorophyll a values and low NH₄⁺ concentrations. High Chlorophyll a concentrations were also found at the center of Raritan Bay accompanied by high NH₄⁺ concentrations. Near Rockaway Inlet, NH₄⁺ concentrations were high while Chlorophyll a values were minimal. The Narrows also showed high NH₄⁺ and low Chlorophyll a concentrations. By comparing the salinity, ammonium, and chlorophyll a distributions at the Sandy Hook-Rockaway Point transect with the characteristics of the different sources of water flowing out to the bight, an identification of water masses at the transect is possible. (Sinha-OEIS) W79-05693

OXYGEN DEPLETION IN THE NEW YORK BIGHT APEX: CAUSES AND CONSEQUENCES,

National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.

D. A. Segar, and G. A. Berberian.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 220-239, 1976. 20 fig, 35 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Dissolved oxygen, *Waste disposal, *Water pollution sources, *Water pollution effects, Environmental effects, Sewage sludge, *Outer Continental Shelf, *New York Bight, Ocean dumping, Dredge spoil.

Dissolved oxygen concentrations in waters of the New York Bight apex are near saturation except in summer when a stable thermocline exists and concentrations in the lower layer can drop to 10% of saturation. Mass balances of oxygen and carbon cycles in the apex were examined. Photosynthetically produced carbon accounts for most of the oxygen demand, particularly in summer. Oxygen demand due to sewage sludge and dredge spoils is small compared to that from organic carbon produced in situ. Oxygen demand of particulate and dissolved organics in the estuarine discharge may be as great as the sewage sludge and dredge spoils together. Midsummer primary productivity in the apex is high due to nutrient inputs, particularly nitrogen. Most nitrogen, supplied to the apex in forms suitable to support photosynthetic production, comes from the discharge of the Hudson-Raritan-Passaic systems. Most of this nitrogen comes from liquid effluents of sewage treatment plants discharged to the rivers. Ocean dumping in the bight apex does not cause the low oxygen concentrations found in summer. These are caused primarily by nitrogen supply from rivers. Improvement in dissolved oxygen concentrations could be achieved by removing nitrogen from sewage treatment plant effluents. (Sinha-OEIS) W79-05694

CARBOHYDRATES AND ORGANIC CARBON IN NEW YORK BIGHT SEDIMENTS AS POSSIBLE INDICATORS OF SEWAGE CONTAMINATION,

National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.

P. G. Hatcher, and L. E. Keister.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 240-248, 1976. 6 fig, 1 tab, 25 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Carbohydrates, *Organic compounds, *Water pollution sources, *Waste disposal, Sediments, Beaches, Sewage sludge, *Outer Continental Shelf, *New York Bight, Ocean dumping.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

Sediments of the New York Bight were analyzed for total organic carbon (TOC) and total carbohydrate (TCH). The TCH:TOC ratio was significantly more elevated than comparable sediments from other areas. High TCH:TOC values may be attributed to sewage-derived materials which contribute significant quantities of refractory organic matter to the bight annually. Nonanthropogenic sources of organic matter to these sediments have little or no influence on TCH:TOC except near the shelf break. The TCH:TOC ratio may be useful as a qualitative and semiquantitative indicator of sewage-derived organic matter in sediment deposits. The observed TCH:TOC ratios suggest that organic material being deposited in the Christensen Basin and mud patches near Long Island is predominantly of sewage origin, and that seaward of the apex, the sedimentary organic matter becomes less influenced by sewage-derived organic matter and oceanic organic matter becomes a more significant fraction. (Sinha-OEIS)

W79-05695

A CONCEPTUAL REPRESENTATION OF THE NEW YORK BIGHT ECOSYSTEM.
Resource Management Associates, Lafayette, CA.; and Tetra Tech, Inc., Lafayette, CA.
D. B. McLaughlin, and J. A. Elder.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 249-259, 1976. 4 fig, 1 tab, 25 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Ecosystems, *Models, *Productivity, Water quality, Environmental effects, Water pollution effects, *Outer Continental Shelf, *New York Bight, Ocean dumping.

Large scientific enterprises need effective techniques for organizing and relating research findings from different fields. Graphical representations (or models) of the ecosystem can be particularly useful organizational tools. These conceptual models help lay the groundwork for detailed mathematical or empirical descriptions of ecological processes; they also demonstrate the scope of the problem being studied. The New York Bight ecosystem model discussed here is based on a descriptive technique developed by H.T. Odum and widely applied by others. The model is constructed from a few basic components which fall into the following categories: energy or mass storage compartments; energy or mass sources; energy or mass flow regulators. These components are pieced together into a comprehensive representation of physical, chemical, and biological processes in the bight. Selected aspects of the representation are examined and, where possible, mass and energy fluxes are estimated. (Sinha-OEIS)

W79-05696

PHYTOPLANKTON PRODUCTIVITY IN THE APEX OF THE NEW YORK BIGHT: ENVIRONMENTAL REGULATION OF PRODUCTIVITY/CHLOROPHYLL A.
City Coll., New York. Dept. of Biology.
T. C. Malone.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 260-272, 1976. 13 fig, 1 tab, 31 ref. Allen Press Inc., Lawrence, Kansas. NOAA-MESA-03-4-043-310.

Descriptors: *Productivity, *Chlorophyll, Phytoplankton, Nitrogen, Environmental effects, Water pollution effects, *Outer Continental Shelf, *New York Bight, Ocean dumping.

Phytoplankton productivity within a 600 sq km area of the New York Bight apex ranged from a December minimum to a June maximum. Net-plankton productivity peaked in February and June; nanoplankton productivity was highest in June and July. Productivity was restricted to

within 20 km of the mouth of the Hudson-Raritan estuary. Netplankton and nanoplankton accounted for 41% and 59% of the annual phytoplankton production. The supply of dissolved inorganic nitrogen from the Hudson estuary exceeded phytoplankton demand except during June, July, and August when regeneration within the apex was an important source of nitrogen. No evidence of nitrogen-limited phytoplankton growth was found. Evidence shows that chlorophyll a specific phytoplankton productivity was regulated by light and temperature. Ocean dumping had no observable effect on phytoplankton assimilation numbers or on the distribution of environmental factors regulating phytoplankton growth in the apex. (Sinha-OEIS)

W79-05697

EFFECTS OF COASTAL POLLUTION ON FISH AND FISHERIES—WITH PARTICULAR REFERENCE TO THE MIDDLE ATLANTIC BIGHT.

National Marine Fisheries Service, Highlands, NJ. Middle Atlantic Coastal Fisheries Center.
For primary bibliographic entry see Field 5C.
W79-05699

ACCOMPLISHMENT PLAN, REGION VIII. RED RIVER OF THE NORTH BASIN.

Environmental Protection Agency, Denver, CO. Region VIII.
For primary bibliographic entry see Field 5G.
W79-05722

FREQUENCY AND EXTENT OF WIND-INDUCED RESUSPENSION OF BOTTOM MATERIAL IN THE U.S. GREAT LAKES NEARSHORE WATERS.

Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 2J.
W79-05736

CHEMISTRY OF PHOSPHORUS, CADMIUM, COPPER, NICKEL, LEAD, AND ZINC IN INDIANA LAKE AND RESERVOIR SEDIMENTS.
Purdue University Water Resources Research Center, West Lafayette, Indiana.

E. D. Orme, and D. W. Nelson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 428. Price codes: A07 in paper copy, A01 in microfiche. Technical Report No. 122. January 1979. 116 p, 50 fig, 32 tab, 49 ref, 1 append. OWRT A-044-IND(2).

Descriptors: *Lake sediments, *Sediment-water interfaces, *Eutrophication, *Phosphorus, *Heavy metals, Metals, Reservoirs, Mud-water interfaces, Bottom sediments.

Soluble inorganic phosphorus is presumed to be the key element in the eutrophication process of a body of water. The objective of the study was to characterize the chemistry of phosphorus and selected heavy metals in sediments from Indiana lakes and reservoirs. Studies were made on the forms and amounts of P, Cd, Cu, Ni, Pb, and Zn initially present in sediments, the capacities of sediments to sorb added phosphorus and metals, and the nature of the mechanisms for phosphorus and metal retention. Results showed that all the sediments had high sorptive and desorptive capacities, although each sediment studied had a unique desorption characteristic. Statistical correlations between sediment parameters revealed that sediment desorption of P was directly related to the degree of eutrophication in the body of water. Because of high positive correlation, the NH₄F-extractable Al and amorphous Fe and Al were most likely the sediment compounds involved with the equilibrium sorption-desorption of phosphorus. Heavy metals were also highly sorbed. Sediments retained or released sorbed metals in the general order of Ni was more easily released while Cu and Cd were more strongly retained. (Wiersma-Indiana)

W79-05794

EFFECT OF ENVIRONMENTAL FACTORS ON SURVIVAL OF SALMONELLA TYPHIMURIUM IN SOIL.
Missouri Univ., Columbia. Dept. of Agronomy.
L. M. Zibilake, and R. W. Weaver.
Journal of Environmental Quality, Vol. 7, No. 4, p 593-597, October-December, 1978. 6 tab, 18 ref.

Descriptors: Waste disposal, Pathogenic bacteria. Laboratory tests, *Salmonella, *Soil bacteria.

This investigation was undertaken in the laboratory to determine how accurately salmonella survival can be predicted when environmental conditions are known. Salmonella typhimurium was inoculated into two Texas soils, a clay and a fine sandy loam, using cattle manure slurry and saline as inoculum carriers. Soil samples were incubated in the laboratory at three temperatures and moistures: 5, 22, and 39°C, and 0, 0.5, and >22 atm tension, respectively. Survival was monitored for 12 weeks by direct spread plating of soil dilutions onto dulcitol-iron thiosulfate (DIT) medium developed for this experiment. The DIT medium restricted growth of normal soil microflora but allowed growth and differentiation of S. typhimurium. Statistical evaluation of treatment effects was complex because of three factor interactions. Soil moisture and temperature interacted as did soil moisture and inoculation method. Time as a factor strongly interacted with moisture, soil, and temperature. S. typhimurium died within 1 week in dry soil incubated at 39°C. For some treatment combinations incubated at 39°C, interactions occurred that resulted in survival to 42 days. Survival at 5 and 22°C was comparable and usually longer than at 39°C. Salmonella populations increased in some samples at 3 days but declined afterward. (Skogerboe-Colorado State)

W79-05807

NITROGEN INPUTS AND LOSSES IN TOBACCO, CO, BEAN, AND POTATO FIELDS IN A SANDY LOAM WATERSHED.
Department of Agriculture, Swift Current (Saskatchewan).

D. R. Cameron, R. DeJong, and C. Chang.
Journal of Environmental Quality, Vol. 7, No. 4, p 545-550, October-December, 1978. 4 fig, 1 tab, 20 ref.

Descriptors: *Nitrogen removal, *Leaching, Nitrates, Denitrification, Fertilization, Tobacco, Beans, Potatoes.

Results from a 2-year study concerned with additions and losses of N from cropped fields in an intensively farmed sandy loam watershed in southern Ontario indicated that heavily fertilized burley tobacco (220 kg N/ha per year) and potato (165 kg N/ha per year) fields can potentially lose up to 52 and 92 kg N/ha per year, respectively, from the 75-cm profile by leaching and denitrification. Mineral N production rates calculated from results obtained in the field over the growing season varied from 0.0 to 0.73 kg N/ha per year. The lower rate resulted from leaching losses. The monitored NO₃-N profile distributions under fertilized burley tobacco and potato crops showed definite leaching patterns. Soil water samples taken periodically from the potato field at 90 and 150 cm showed NO₃-N moving through the lower profile in response to rainfall events. A plot treated with Cl showed no significant Cl leaching losses until early fall when rains moved about 45% of the added Cl below 75 cm. (Skogerboe-Colorado State)

W79-05819

SIMAZINE RESIDUE LEVELS IN IRRIGATION WATER AFTER DITCHBANK APPLICATION FOR WEED CONTROL.

Science and Education Administration, Denver, CO. Aquatic Weed Control Research Lab.
L. W. J. Anderson, J. C. Pringle, R. W. Raines, and D. A. Sianeros.
Journal of Environmental Quality, Vol. 7, No. 4, p 574-579, October-December, 1978. 8 fig, 2 tab, 20 ref.

Descriptors: weeds, *Herbicide application, *Herbicide residues, *Irrigation water, *Simazine, *Weed control.

A field study was conducted to determine the amount of simazine that would be required after ditchbank application to control weeds. The impact of ditchbank application on water quality was also determined. The results showed that 7.43 kg water/m² of simazine was required to control weeds. The results also showed that the water quality was not affected by the application of simazine. (Skogerboe-Colorado State)

REDOX POTENTIALS IN A POTATO FIELD.
FOSAL Fertilizer Science and Technology, ID. Snake J. H. Smith.
Journal of Environmental Quality, Vol. 7, No. 4, p 571-574, October-December, 1978. 4 fig, 1 tab, 20 ref.

Descriptors: water disposal, *Nitrate, *Potatoes, *Redox potential, *Soil bacteria.

Redox potentials were measured in a potato field at seven depths (0, 10, 20, 30, 40, 50, and 60 cm) during the summer, autumn, and winter. The results showed that the redox potential was highest in the 0-10 cm depth during the summer and lowest in the 60 cm depth during the winter. The results also showed that the redox potential was highest in the 0-10 cm depth during the autumn and lowest in the 60 cm depth during the winter. (Skogerboe-Colorado State)

NITROGEN FROM ORGANIC MATTER IN A POTATO FIELD.
Cornell Univ., Ithaca, NY.
J. M. Duxbury.
Journal of Environmental Quality, Vol. 7, No. 4, p 566-570, October-December, 1978. 4 fig, 1 tab, 20 ref.

Descriptors: Leaching, *Nitrate, *Potatoes, *Soil bacteria.

The nutrient status of a potato field was determined by measuring the amount of nitrogen in the soil. The results showed that the nutrient status was highest in the 0-10 cm depth and lowest in the 60 cm depth. The results also showed that the nutrient status was highest in the 0-10 cm depth during the summer and lowest in the 60 cm depth during the winter. (Skogerboe-Colorado State)

Sources Of Pollution—Group 5B

Descriptors: *Aquatic weed control, Aquatic weeds, *Herbicides, *Irrigation water, Gas chromatography, Simazine.

A field study was conducted to determine the amount of simazine (2-chloro-4,6-bis (ethylamino)-s-triazine) likely to be found in irrigation water after ditchbank treatment for weed control. Resulting data are useful in evaluating the potential impact of simazine on crops irrigated from sprayed canals. Canals were selected in California, Colorado, and Washington for the application of simazine to both watered and dewatered sites at rates of 2.25 to 7.43 kg/ha. Simazine levels in flowing canal water immediately after herbicide application did not exceed 60 micrograms/liter. In first-flow samples collected in the spring from the sites that were dewatered at application, simazine levels peaked at about 250 micrograms/liter within the treated section but decreased rapidly to <5 micrograms/liter. (Skogerboe-Colorado State) W79-05821

REDOX POTENTIALS IN A CROPPED POTATO PROCESSING WASTE WATER DISPOSAL FIELD WITH A DEEP WATER TABLE. Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center. J. H. Smith, R. G. Gilbert, and J. B. Miller. Journal of Environmental Quality, Vol. 7, No. 4, p 571-574, October-December 1978. 2 fig, 2 tab, 9 ref.

Descriptors: *Oxidation-reduction potential, Waste water disposal, Denitrification, Nitrification, Nitrogen, Nitrates, Flood irrigation.

Redox potential measurements were made in a field irrigated with potato processing waste water at seven depths of 5 to 150 cm for 14 mo. Irrigation with canal water mixed with waste water in the summer, and with waste water in the winter, decreased redox potentials in the field at some depths for a short time but not enough to cause denitrification. However, as the soil temperature increased in the spring, and decomposition of the accumulated waste organic matter accelerated, redox potentials decreased after each irrigation at all observed depths. During April, redox potentials low enough to promote denitrification (below +225 mV) at 90-, 120-, and 150-cm depths in the soil persisted for 2 weeks. Irrigation with nondiluted waste water in June and July decreased redox potentials and denitrification occurred for up to 3 days after irrigations. As the soil temperature increased in the spring, nitrification of accumulated organic matter increased soil nitrates. Waste water irrigations from April to July promoted denitrification, removing most of the nitrate from the soil, and thereby decreasing the potential for groundwater pollution. (Skogerboe-Colorado State) W79-05822

NITROGEN AND PHOSPHORUS LOSSES FROM ORGANIC SOILS. Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy. J. M. Duxbury, and J. H. Peverly. Journal of Environmental Quality, Vol. 7, No. 4, p 566-570, October-December, 1978. 3 fig, 2 tab, 15 ref.

Descriptors: *Nutrient removal, Organic soils, Leaching, Nitrogen, Phosphorus, Drainage water.

The nutrient content of drainage water from Histoils located in New York was monitored from June 1975 through July 1977. Continuous flow records and nutrient concentration data obtained from daily composite samples were used to calculate annual nutrient outputs which ranged from 0.6 to 30.7 kg/ha for $PO_4(3)-P$, 39.2 to 87.5 kg/ha for $NO_3(-)-N$, and <1.0 to 1.9 kg/ha for $NH_4(+)-N$. Nutrient concentrations in the drainage water increased with increasing flow, so that the greatest output of nutrients was during late winter and spring high-flow events. Maximum observed concentrations were 35 mg/liter for $NO_3(-)$ and 10 mg/liter for $PO_4(3)-P$. The amount of N lost in drainage water was similar at all sites and was

about 10% of that mineralized; the remainder was presumed to be denitrified. The fiftyfold variability in phosphorus output appeared to be related to interactions within the soil profile rather than fertilizer practices, although these probably contributed to the generally high levels found. It was concluded that fertilizer nitrogen additions were unlikely to affect the quantity of $NO_3(-)$ leached. The study showed that organic soils can contribute to N and P in land runoff in much greater proportions than indicated by their area. (Skogerboe-Colorado State) W79-05823

STREAM CHEMISTRY AND WATERSHED NUTRIENT ECONOMY FOLLOWING WILDFIRE AND FERTILIZATION IN EASTERN WASHINGTON.

Pacific Northwest Forest and Range Experiment Station, Wenatchee, WA. Forest Hydrology Lab. A. R. Tiedemann, J. D. Helvey, and T. D. Anderson.

Journal of Environmental Quality, Vol. 7, No. 4, p 580-588, October-December, 1978. 2 fig, 7 tab, 49 ref.

Descriptors: *Streams, *Forest fires, Fertilization, Ureas, Ammonium compounds, Nutrients, Washington.

During the first three years after a severe wildfire in 1970, maximum concentrations of nitrate-N (NO_3-N) in stream water increased from prefire levels of <0.016 to 0.56 mg/liter on a burned, unfertilized watershed and to 0.54 and 1.47 mg/liter on two watersheds that were burned and fertilized. Maximum NO_3-N concentration in the stream from an unburned watershed was 0.066 mg/liter. Organic N concentrations in streamflow were nearly doubled during the second year after fire compared to prefire levels. Concentrations of total phosphorus in streams from one burned and two burned-fertilized watersheds were 1.5 to 3 times greater than from an unburned watershed. Combined concentrations of Ca, Mg, K, and Na in streams prior to fire ranged from 12.0 to 14.9 mg/liter. Concentrations declined to 7.4-10.5 mg/liter in streams from burned and burned-fertilized watersheds during the second year after fire (1972) because of dilution resulting from increased discharge and were still less in 1975 than prefire levels. Average inputs of N, P, and the four cations during the five years of study were 1.23, 0, and 3.56 kg/ha per year. Yearly N input from precipitation was sufficient to balance solution losses in three of the five postfire years. Cation losses in solution greatly exceeded precipitation inputs in all years. Results indicate that fire and fertilization exerted negligible effects on chemical water quality for municipal use. (Skogerboe-Colorado State) W79-05824

GROUNDWATER POLLUTION. PART 2. POLLUTION FROM IRRIGATION AND FERTILIZATION. VOL. 2. 1977-JANUARY, 1978. (CITATIONS FROM THE NTIS DATA BASE).

National Technical Information Service, Springfield, VA.

Available from the National Technical Information Service, Springfield, VA 22161 as NTIS/PS-78/0141. Price codes: N01 in paper copy, N01 in microfiche. February, 1978. R. J. Brown, Editor. 65 p.

Descriptors: *Abstracts, *Bibliographies, *Groundwater pollution, Irrigation, Fertilization.

The bibliography contains abstracts of Federally-funded research covering aspects of groundwater pollution from irrigation and fertilization. The reports include topics dealing with the pollution from sewage and waste water irrigation, land spreading of sludges and solid wastes, nitrate and phosphate accumulation in soils, pollution control and abatement planning, salt build-up from irrigation, the use of tile drains in groundwater pollution control, and groundwater recharge studies. (Skogerboe-Colorado State) W79-05826

QUALITY OF SELECTED WATERS IN SOUTHERN MAINE.

Maine Dept. of Environmental Protection, Augusta. Bureau of Water Quality Control. Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 729. Price codes: A03 in paper copy, A01 in microfiche. Report 1976. 47 p.

Descriptors: *Maine, *Water quality, *Data collections, Discharge(water), Design, Design data, Monitoring, Evaluation, Planning, Sampling, Analysis, Phosphorus, Gaging stations, Gaging, Drainage, Tidal waters, Salinity, Water temperature, Dissolved oxygen, Dissolved solids, Coliforms, Heavy metals, Nitrogen.

The report is a compilation of water quality data determined from a number of water bodies in the southern Maine area. The data were accumulated pursuant to the continuing need of the Department of Environmental Protection (DEP) to develop background indications of existing water quality in the area. Guidance was accepted from the Southern Maine Regional Planning Commission (SMRPC) in the design of the monitoring program in order to meet the mutual needs of the organizations. The report is a continuation of similar efforts begun in 1975. Project management was provided by the DEP's Division of Water Quality Evaluation and Planning in conjunction with the SMRPC. Sample collection and analysis were performed by the Department's Division of Laboratory and Field Services. Water quality data were determined according to EPA guidelines promulgated in FR 38 (199), p. 28758. Exceptions are the total phosphorus and NO_3+NO_2-N determinations for which Department modifications were used. Discharge data in the Great Works River were provided by the USGS according to state-of-the-art techniques. Goosefare Brook discharge data were determined by the DEP. Discharge data were provided only at gaged stations, and extrapolation by drainage areas for calculated values at different stations was left to the reader. Time of Travel along the Great Works data was determined by the DEP according to USGS fluorometric techniques. Sample locations were described as completely as reasonably possible on individual data sheets. The description should allow the reader to find the exact location using a 15 minute USGS topographic map. Otherwise, maps showing sample stations are available in the DEP. (Froehlich-ISWS) W79-05832

SURFACE WATER QUALITY ASSOCIATED WITH THE SURFACE MINING OF IOWA COAL.

Iowa State Univ., Ames. Energy and Mineral Resources Research Inst.

J. B. Gulliford, R. B. Wildman, and L. K. Payne. Available from the National Technical Information Service, Springfield, VA 22161 as IS-ICP-55. Price codes: A03 in paper copy, A01 in microfiche. Report IS-ICP-55, November 7, 1977. 29 p, 7 fig, 5 tab, 3 ref, 1 append.

Descriptors: *Mining, *Acid mine water, *Mine acids, *Mine wastes, *Iowa, Strip mine wastes, Sediments, Chemicals, Pollutants, Sediment control, Water treatment, Water pollution, Water pollution sources, Water quality, Surface waters, On-site investigations, Coal mines, Coal mine wastes, Path of pollutants.

The production of acid mine drainage has long been a problem associated with the surface mining of coal, and typically high levels of sulfur in both coal and shale overburden make this problem particularly acute in Iowa. The Iowa Coal Project Demonstration Mine No. 1 was operated as a research mine to determine and examine the environmental problems associated with the surface mining of Iowa coal. A major problem identified during mining was that of available operating space. When the problem of acid mine drainage treatment accessibility was identified, the mining operation was without space to correct it. It was recommended that provision for expanding acid mine drainage treatment facilities be a part of all

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

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mine plans. A well-organized haul-back mining plan also can provide the opportunity to reduce the acid mine drainage from a surface mine. By directing the surface runoff from the mine site around the active pit and into the sediment pond, less water is exposed to toxic shales to produce acid mine drainage. This diverted water will still carry a sediment load, but it will not require neutralization. It was recommended that any methods of reducing acid generation be utilized to reduce the cost and difficulty of water treatment. (Sims-ISWS)
W79-05834

DISPOSAL OF A LARGE QUANTITY OF SODIUM FLUOROACETATE IN A SANITARY LANDFILL SITE LOCATED IN AN AQUIFER RECHARGING AREA.
Jefferson County Health Department, Lakewood, CO.; and Colorado Univ., Denver. School of Medicine.
For primary bibliographic entry see Field 5G.
W79-05835

PARAMETER ESTIMATION OF STREETER-PHELPS MODELS.
Politecnico di Milano, Milan (Italy).
S. Rinaldi, P. Romano, and R. Soncini-Sessa.
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol. 105, No. EE1, Proceedings Paper 14377, p 75-88, February 1979. 5 fig, 1 tab, 20 ref, 2 append.

Descriptors: *Water quality, *Water pollution, *Model studies, *Mathematical models, Biochemical oxygen demand, Dissolved oxygen, Oxygen, Rivers, Foreign countries, Foreign research, Pollutants, Measurement, Environment, Environmental engineering, Data processing, Analytical techniques, *Italy, *Bormida River(Italy), *Parameter estimation, Parameters.

A method for the estimation of the parameters of generalized Streeter-Phelps river quality models was developed in this paper. The method is quite flexible since it does not require any uniformity in the geometry of the measurement points and can be used in the case in which only DO data are available. The validity of the method was tested by means of real data collected on the Bormida river in northern Italy, and the corresponding results and difficulties were pointed out. Finally, the sensitivity of the method with respect to missing data was analyzed. (Sims-ISWS)
W79-05841

MONITORING AREA-WIDE RURAL WATER QUALITY.
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5A.
W79-05842

AN AUTOMATIC SEQUENTIAL RAIN SAMPLER.
Laboratoire de Chimie Inorganique et Nucleaire, Chemin du Cyclotron, Louvain (Belgium).
For primary bibliographic entry see Field 7B.
W79-05847

THE OCCURRENCE OF ORGANOCHLORINE RESIDUES IN RAINWATER.
Freshwater Fisheries Lab., Pitlochry (Scotland).
For primary bibliographic entry see Field 5A.
W79-05848

WET AND DRY DEPOSITION OF NUTRIENTS IN CENTRAL ALBERTA.
Alberta Univ., Edmonton.
R. Caiazza, K. D. Hage, and D. Gallup.
Water, Air, and Soil Pollution, Vol. 9, No. 3, p 309-314, April 1978. 1 fig, 4 tab, 5 ref.

Descriptors: *Fallout, *Nutrients, *Canada, *Water pollution sources, On-site investigations, Phosphates, Sulfates, Nitrogen, Iron, Sodium, Po-

tassium, Rain water, Rain, Snow, Data collections, *Alberta(Canada).

Dry and wet deposition rates of various forms of phosphate and N and of Fe, sulphate, Na, K, and silica ions were reported for a 1 yr period in central Alberta. The results were extrapolated from event samples of rain and snow, and from dry deposition samples in distilled water collectors and snowpack. Following corrections for contamination and evaporation, the most reliable dry deposition rates were found for orthophosphate; organic and nitrate N; and Fe, sulphate, and K ions. Ion concentrations in snow were significantly lower than those in rain for ammonia, organic and total N, and for sulphate and silica ions. More than 50% of the concentrations of total phosphate and total N in wet deposition samples is dissolved or in fine particles (less than 0.45 micrometer), but only about 1/3 of dry deposition sample concentrations is in such form. Dry-to-wet deposition ratios for the year exceed one for filtered total N, filtered total phosphate, Fe, and sulphate. The largest dry-to-wet deposition ratios are about 5 for sulphate and unfiltered total N. It seems clear that both wet and dry depositions of these nutrients are important for lakes in central Alberta. (Humphreys-ISWS)
W79-05849

DETECTION OF HEAVY METAL POLLUTION IN ESTUARINE SEDIMENTS.
Florida State Univ., Tallahassee. Dept. of Oceanography; and Florida State Univ., Tallahassee. Florida Resources and Environmental Analysis Center.
J. O. Pilotte, J. W. Winchester, and R. C. Glassen.
Water, Air, and Soil Pollution, Vol. 9, No. 3, p 363-368, April 1978. 1 fig, 2 tab, 4 ref.

Descriptors: *Heavy metals, *Pollutants, *Estuaries, *Florida, Sediments, Estuarine environment, Water pollution sources, Surveys, Nickel, Lead, Iron, Copper, Data collections, Potassium, Chromium, Manganese, Zirconium, Rubidium.

Anomalies in the concentrations of heavy metals in estuarine sediments may not be reliably detected based on the measured concentration values or the ratios of metal concentrations to those of a reference element because of natural variations in both. However, the departure of a measurement from a regression line between metal and reference element concentrations may serve as a criterion for detecting an anomaly. The procedure has been applied to a suite of 34 sediments from the Bayou Chico, a Florida estuary. As a group, the buried sediment samples showed greater variability in composition relative to Rb than did the surface sediment samples; the reasons may be geochemical unrelated to pollution, and anomalies may include both low and high concentrations. A comparison of each metal concentration with that of Rb selected as a reference element by means of a regression equation was valuable in identifying the presence or absence of anomalous heavy metal concentrations. (Humphreys-ISWS)
W79-05850

TRACE METAL TRANSPORT FROM MINING, MILLING, AND SMELTING WATERSHEDS.
Syracuse Univ., NY.
J. C. Jennett, and J. L. Foil.
Journal of the Water Pollution Control Federation, Vol. 51, No. 2, p 378-404, 1979. 10 fig, 9 tab, 42 ref.

Descriptors: *Water pollution, *Heavy metals, *Mining, *Path of pollutants, *Missouri, Pollutants, Water pollution sources, Mine wastes, Lead, Zinc, Copper, Cadmium, Manganese, Sediments, Suspended solids, Sediment transport, Streams, Runoff, Precipitation(Atmospheric), Watersheds(Basins), Sampling, Chemical analysis, Milling wastes, Smelting wastes.

The world's newest and largest lead-zinc mining district is known as the 'New Lead Belt' of 'Viburnum Trend' of southeast Missouri; within the past decade, the region has become the producer of 80% of the lead needed in the U.S. Because the district is located almost entirely within the bound-

aries of Clark National Forest, one of Missouri's most undisturbed wilderness areas, and because the area abounds in wild, unpolluted, and uninhabited stream basins, the area has become a laboratory for the study of lead and zinc in the aquatic environment. This study took advantage of this natural region to evaluate the effects of the new, large lead and zinc mining, milling, and smelting operations on the chemical and physical quality of the aquatic environment. It was found that under normal non-runoff conditions, the receiving stream physical and chemical water quality below the mining, milling, and smelting operations of the New Lead Belt is not radically different from that of the control streams in the region. The only significant difference is that turbidity and suspended solids levels were slightly higher in receiving streams and that heavy metals were found to be associated with the solids. The primary reason for these streams being unaffected by the mining and milling operations seems to be that the receiving streams have a relatively basic pH and a relatively high carbonate content. This causes any metal that escapes the operation to be precipitated rapidly as a finely divided particle. These particles may either fall to the sediments or be carried with the normal stream flow. (Sims-ISWS)
W79-05858

QUANTITATIVE ANALYSIS OF AIRCRAFT MULTISPECTRAL-SCANNER DATA AND MAPPING OF WATER-QUALITY PARAMETERS IN THE JAMES RIVER IN VIRGINIA.
National Aeronautics and Space Administration, Langley Station, VA. Langley Research Center.
For primary bibliographic entry see Field 7B.
W79-05862

TECHNOLOGY AND ECONOMICS OF INDUSTRIAL POLLUTION ABATEMENT.
Illinois Inst. for Environmental Quality, Chicago.
J. W. Patterson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 338. Price codes: A99 in paper copy, A01 in microfiche. Report No. IIEQ, October 1976. 620 p, 97 fig, 156 tab, 948 ref. 20.070 A.

Descriptors: *Pollutant identification, *Water pollution sources, *Water pollution treatment, *Waste water treatment, *Industrial wastes, Costs, Economics, Arsenic compounds, Cadmium, Chromium, Copper, Fluorides, Iron, Lead, Manganese, Mercury, Nickel, Nitrogen, Ammonia, Nitrates, Oil wastes, Phenols, Selenium, Dissolved solids, Zinc.

Information on 23 water pollutants regulated by the state of Illinois is presented. Each pollutant is discussed in a separate chapter in which industrial sources are identified and typical levels of the pollutant are discussed. Available treatment technology for the specific pollutant is described with regard to the operational method of the technology, its limitations, the treatment levels which have been accomplished in the application of that technology, and the economics of each technology. (Davison-IPA)
W79-05865

LEACHING OF CATIONS AND CHLORIDE FROM MANURE APPLIED TO AN IRRIGATED SOIL.
California Univ., Riverside. Dept. of Soil and Environmental Science.
P. F. Pratt.
Journal of Environmental Quality, Vol. 7, No. 4, p 513-516, October-December, 1978. 3 fig, 15 ref.

Descriptors: Leachate, *Leaching, Organic wastes, *Cations, Chlorides, *Irrigation.

Data for leached cations, (the sum of Ca(2+), Mg(2+), Na(+), and K(+)), and leached Cl(-) and the ratio of cations to Cl(-) leached from the root zone during a 4-year experiment with bovine manures on a Hanford soil were presented. Cation accumulation in the soil and the cations leached were linearly correlated with cation input. The

Sources Of Pollution—Group 5B

removal of cations in harvested crops reached a maximum and then decreased as the input of cations increased. Leached Cl^- increased at a ratio of 1:1 with the Cl^- input in excess of removal in harvested crops, whereas leached cations increased with increase in inputs in excess of removal in crops and decreased with decrease in the volume of leachate. At low leachate volumes and with dry weights of liquid and solid manures at 21 and 40 metric tons/ha per year, respectively, the cations leached were less than in the check plots. At high leachate volumes manures increased the cations leached relative to the check treatment at all rates of manure. The dominant factor in cation leaching was volume of leachate. Carefully controlled irrigation to attain low leachate volumes combined with manure applications at reasonable rates could be used to reduce the overall effect of irrigation on the leaching of salts to groundwaters. (Skogerboe-Colorado State) W79-05931

TRANSPORT OF ANTIBIOTIC-RESISTANT ESCHERICHIA COLI THROUGH WESTERN OREGON HILLSLOPE SOILS UNDER CONDITIONS OF SATURATED FLOW, Oregon State Univ., Corvallis. Dept. of Soil Science; and Oregon State Univ., Corvallis. Dept. of Microbiology.

T. M. Rahe, C. Hagedorn, E. L. McCoy, and G. F. Kling. Journal of Environmental Quality, Vol. 7, No. 4, p 487-494, October-December, 1978. 3 fig, 3 tab, 16 ref.

Descriptors: Sewage effluents, *Coliforms, Groundwater, Tracers, *Septic tanks, Sewage disposal, Perched water, Subsurface flow.

Field experiments using strains of antibiotic resistant *Escherichia coli* were conducted to evaluate the events which would occur when a septic-tank drainfield became submerged in a perched water table and fecal bacteria were subsequently released into the groundwater. Three separately distinguishable bacterial strains were inoculated into three horizontal lines installed in the A, B, and C horizons of two western Oregon hillslope soils. Movement was evaluated by collecting groundwater samples from rows of modified piezometers (six piezometers/row) placed at various depths and distances downslope from the injection lines. Transport of *E. coli* differed at both sites with respect to movement rates, zones in the soil profiles through which major translocation occurred, and the relative numbers of cells transported over time. Movement rates of at least 1,500 cm/hour were observed in the B horizon at one site. The strains of *E. coli* survived in large numbers in the soils examined for at least 96 hours and appeared to be satisfactory as tracers of subsurface water flow. The concept of partial displacement (or turbulent flow through macropores) was discussed as an explanation of the rapid movement of substantial numbers of microbial cells through saturated profiles. (Skogerboe-Colorado State) W79-05932

BIOLOGICAL HYDROLYSIS OF PARATHION IN NATURAL ECOSYSTEMS, Central Rice Research Inst., Cuttack (India). Lab. of Soil Microbiology.

B. Sudhakar, and N. Sethunathan. Journal of Environmental Quality, Vol. 7, No. 3, p 346-348, July-September, 1978. 5 tab, 11 ref.

Descriptors: *Organophosphorus compounds, *Flooding, Hydrolysis, *Parathion, *Hydrolysis.

Parathion (0,0-diethyl 0,p-nitrophenyl phosphorothioate) was applied to flooded soils and to water and sediment river, lake, and pond samples at 15-day intervals. While p-nitrophenol (0,0-dimethyl 0,p-nitrophenyl phosphorothioate), the hydrolysis product of parathion, was not detected, even at the end of 12 days after the first addition, it was detected in all samples within 6 hours after two or three additions of the insecticide. Enrichment cultures from the samples of different ecosystems lost their ability to hydrolyze parathion following auto-

claving, suggesting microbial participation in parathion hydrolysis. (Skogerboe-Colorado State) W79-05933

PRECIPITATION AND THROUGHFALL CHEMISTRY IN THE SAN FRANCISCO BAY AREA, California Univ., Berkeley. Dept. of Soils and Plant Nutrition.

J. G. McColl, and D. S. Bush. Journal of Environmental Quality, Vol. 7, No. 3, p 352-357, July-September, 1978. 3 fig, 1 tab, 36 ref.

Descriptors: *Precipitation (Atmospheric), Throughfall, Rainfall, Chemical analysis, Forest soils, *Air pollution, Nutrients, California.

At Berkeley, California, main ionic constituents of bulk precipitation during the wet season of 1974-1975 were SO_4^{2-} , Cl^- , HCO_3^- , Na^+ , and Ca^{2+} , and mean H^+ concentration was 10.7 ± 0.15 microequivalents/liter (pH 5.0). Although SO_4^{2-} comprised 50% of the anions in bulk precipitation, H^+ concentration had the highest correlation with NO_3^- . Impacted air pollutants accumulated on tree leaves between major rainstorms. Atmospheric N and S were correlated with NO_3^- and SO_4^{2-} in bulk precipitation resembled that of surface-soil solution in an adjoining, recently clear-cut area. (Skogerboe-Colorado State) W79-05937

TIMING AND RATE OF FERTILIZER NITROGEN FOR SUGARBEETS RELATED TO NITROGEN UPTAKE AND POLLUTION POTENTIAL, California Univ., Davis. Dept. of Soil Microbiology.

F. J. Hills, F. E. Broadbent, and M. Fried. Journal of Environmental Quality, Vol. 7, No. 3, p 368-372, July-September, 1978. 4 fig, 3 tab, 11 ref.

Descriptors: *Nitrogen, Fertilization, Nutrient requirements, *Sugar beets, Crop production, Tracers.

Nitrogen (N) uptake by sugarbeets (*Beta vulgaris* L.) from fertilizer and soil, as related to time and rate of application, was evaluated at Davis, California, in two field experiments utilizing ^{15}N -labeled ammonium sulfate. There were no significant differences in root, top, or sugar yield when fertilizer N (135 kg/ha) was applied at planting, at thinning, split equally between thinning and layby, or split equally between planting, thinning, and layby. Also, there were no substantial differences in soil or fertilizer N in tops and roots in response to these dates of application. Fertilizer N recovery was 47% when 112 kg N/ha were applied to achieve maximum sugar yield. Roots removed as much N as that applied and tops contained an additional 105 kg N/ha. When applied N was 2.5 times the amount required for maximum sugar yield, tops and roots contained almost as much N as applied. The sugarbeet crop, carefully fertilized, has potential for alleviation of nitrate pollution of groundwater. (Skogerboe-Colorado State) W79-05939

EFFECTS OF SO_2 AND NO_2 ON NITRIFICATION IN SOIL, Abbott Lab., North Chicago, IL.

D. Labeda, and M. Alexander. Journal of Environmental Quality, Vol. 7, No. 4, p 523-526, October-December, 1978. 4 fig, 1 tab, 24 ref.

Descriptors: Air pollution, *Nitrification, Nitrates, *Fumigants, Nitrates, Ecology, Soil chemistry, *Sulfur dioxide.

Nitrification in Lima loam, pH 7.2, was not affected by continuous exposure of the soil to 0.5 ppm of SO_2 or to brief exposures to higher SO_2 levels. Such treatment did not increase the levels of soluble K, Mg, Ca, Mn, Fe, and Al. Intermittent exposure of Hudson silty clay loam, pH 5.0, to SO_2 reduced the rate of nitrate formation. Continuous

fumigation of the acid soil with 10 ppm of SO_2 decreased the rate of nitrification, and continuous fumigation with as little as 1.0 ppm increased the quantity of soluble Mn and Fe. Continuous fumigation of Lima loam with 5 ppm NO_2 inhibited the rate of ammonium disappearance, led to greater rates of nitrate formation, and resulted in nitrite accumulation. Nitrite at a level of 30 micrograms/Ng of soil also reduced the rate of ammonium disappearance. The results demonstrated that nitrification in certain soils could be inhibited in areas acutely polluted with SO_2 and NO_2 . (Skogerboe-Colorado State) W79-05940

GROWTH AND ELEMENTAL COMPOSITION OF CORN AND BEAN SEEDLINGS AS INFLUENCED BY SOIL APPLICATION OF COAL ASH, Savannah River Ecology Lab., Aiken, SC.

D. C. Adriano, T. A. Woodford, and T. G. Ciravolo. Journal of Environmental Quality, Vol. 7, No. 3, p 416-421, July-September, 1978. 5 tab, 43 ref.

Descriptors: *Coal mine wastes, Corn, Beans, Crop production, Soil chemical properties, Fossil fuels, *Fly ash, Toxicity, Salinity, Deficient elements.

Analyses of 0.1N HCl extracts of ash (slag + fly ash) samples from bituminous coal revealed high concentrations of K, Ca, and Fe and intermediate concentrations of P, Mg, Cu, Mn, and Zn. Of the elements analyzed, the extractable concentrations increased as particle size decreased from > 1,000 micron to < 105 micron. The slightly acidic ashes were mixed with Troup sandy loam at rates of 5, 10, and 20% by weight and equilibrated in a glasshouse for 1 mo before planting. 'Coarse' ash was used at only the 10% rate. Corn and bush bean yields from ash-amended soils were statistically equal to yields from a control treatment but significantly lower than fertilized treatment. Corn exhibited P deficiency symptoms while symptoms characteristic of B toxicity occurred in beans. Analyses of tissues of both crops indicated that P concentrations were at deficiency levels while Cu, Mn, and Zn were deficient to marginal. Iron, however, appeared to be in the normal range. Salinity as indicated by EC of leachate of 3 mmhos/cm or greater, B excess as indicated by the toxicity symptoms in beans, and P deficiency as indicated by low P concentrations in plant tissues could limit crop growth in ash-treated soils. (Skogerboe-Colorado State) W79-05942

THE UPTAKE OF ^{203}Hg -LABELED MERCURY COMPOUNDS BY BROMEGRASS FROM IRRIGATED UNDISTURBED SOIL COLUMNS, Saskatchewan Univ., Saskatoon. Dept. of Soil Science.

T. J. Hogg, J. R. Bettany, and J. W. B. Stewart. Journal of Environmental Quality, Vol. 7, No. 3, p 445-450, July-September, 1978. 1 fig, 8 tab, 17 ref.

Descriptors: *Mercury, *Sewage effluent, Sewage disposal, Environmental effects, *Bromegrass, Irrigation, Leachate, Organic matter.

Bromegrass (*Bromus inermis*) was grown under conditions of sewage effluent irrigation on undisturbed soil columns in which the 0- to 10-cm layers had been treated with 10 micrograms Hg/g soil as ^{203}Hg -labeled mercuric chloride (HgCl_2), phenyl mercuric acetate (PMA), and methyl mercuric chloride (MMC). Mercury concentrations in plant dry matter decreased over three successive harvests and highest values were found on MMC-treated soils of fine texture and low organic matter content (2.0 to 0.2 micrograms Hg/g for first and third harvest, respectively). Exposure of the plants and soils to simulated fall conditions resulted in a small but significant increase in the Hg concentration of plant dry matter. Higher levels of Hg were found in plant stems than plant foliage at the termination of the experiment and even higher levels in the main roots and fine roots separated

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

from the 0-10 cm soil layer. Mercury concentration of roots decreased with depth for all Hg treatments, but were still 150 times greater than background levels in the MMC-treated soils at the 40- to 60-cm depth. A significant amount of all forms of applied Hg (10-32%) was lost during the experiment, presumably by volatilization. The majority of the remaining Hg in the soil was found to be strongly bound and not extractable by weak salt solutions, dilute acids, and chelates. (Skogerboe-Colorado State)
W79-05943

INFLUENCE OF THE CHEMICAL FORM OF MERCURY ON ITS ADSORPTION AND ABILITY TO LEACH THROUGH SOILS

Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
T. J. Hogg, J. W. B. Stewart, and J. R. Bettany.
Journal of Environmental Quality, Vol 7, No 3, p 440-445, July-September, 1978. 2 fig, 4 tab, 19 ref.

Descriptors: *Mercury, *Adsorption, *Leaching, Volatility, Sewage effluents, Sewage disposal, Soil analysis.

The adsorption of Hg by two soils, differing in chemical and physical characteristics, indicated that methyl mercuric chloride (MMC), phenyl mercuric acetate (PMA) and mercuric chloride (HgCl₂) followed the linear form of the Langmuir adsorption isotherm. The highest adsorption maxima for all Hg compounds were found for the soils which had the higher organic matter content and clay content. Adsorption maxima increased in the order MMC < PMA < HgCl₂. A two-rate effluent leaching experiment was conducted utilizing undisturbed soil cores of the same two soils and the same three Hg compounds (labeled with 203Hg) which were applied uniformly to the top 0-10 cm of each column. In contrast to the movement of other cations in the effluent and soil, even at the higher irrigation rate, none of the applied Hg was found to move below the 10- to 20-cm soil layer. The lack of movement of Hg and the high adsorption maxima was a consequence of the strong binding between Hg compounds and soil. The inability of weak chemical extractants (CaCl₂, NH₄OAc, DTPA, EDTA) to remove significant quantities of Hg confirmed this hypothesis. Seven to 31% of the applied Hg was lost from the columns during the experiment presumably by volatilization. (Skogerboe-Colorado State)
W79-05944

EFFECT OF SEPTIC TANK EFFLUENT ON THE BASE STATUS OF TWO TILE-DRAINED SOILS

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
R. B. Reneau, Jr., W. F. Kittell, and C. D. Peacock, Jr.
Soil Science, Vol 127, No 2, p 117-126, February 1979. 9 fig, 2 tab, 11 ref.

Descriptors: *Sewage effluents, *Septic tanks, *Soil water, *Groundwater, Soils, Soil types, Chemicals, Chemical analysis, Sodium, Calcium, Magnesium, Potassium, Water levels, Water supply, Effects, Water pollution, Water pollution effects, Pollutants, Path of pollutants, Drainage, Tile drainage, Water quality, Water chemistry.

Changes in SAR (sodium adsorption ratio), pH, and EC (electrical conductivity) of shallow groundwaters as a result of disposal of septic tank effluents into wet-tile-drained soils (Typic and Acric Ochraqualls) were studied during 1974, 1975, and 1976. Changes in these constituents in groundwaters were monitored at selected distances from the drainfield (by placement of sampling wells in the direction of groundwater flow) in waters intercepted by the agricultural tile, and control wells. Sodium adsorption ratio, pH, and EC generally decreased with increasing distance from the disposal area. The SAR decreased from 20 to 25 in samples adjacent to the drainfield to less than 2 in the control wells. The SAR in the drinking water supply was 40. Soil samples were collected to the 160-cm depth at distances corre-

sponding to the location of water-table wells. Changes in ESP (exchangeable sodium percentage), BS (base saturation), and pH occurred in both the Typic and Acric Ochraqualls and reflected changes detected in groundwater samples. Increased ESP, BS, and pH were observed adjacent to the disposal area in the argillic horizons when compared to the surface horizons. Values for these constituents in the argillic horizon decreased with increased sampling distance from the disposal area. In the control profile, their distribution was reversed, the surface horizon normally having increased ESP, BS, and pH compared to the subsurface horizons. (Sims-ISWS)
W79-05945

EXTRACTABILITY OF CADMIUM, COPPER, NICKEL, AND ZINC BY DOUBLE ACID VERSUS DTPA AND PLANT CONTENT AT EXCESSIVE SOIL LEVELS

Science and Education Administration, Beltsville. Fruit Lab.
R. F. Korcak, and D. S. Fanning.
Journal of Environmental Quality, Vol 7, No 4, p 506-512, October-December, 1978. 1 fig, 9 tab, 18 ref.

Descriptors: Trace elements, *Heavy metals, Corn, *Sewage sludge, Correlation analysis, Cadmium, Copper, Nickel, Zinc.

Cadmium, copper, nickel, and zinc were applied as sulfate salts to samples of surface horizons of three Maryland soils in the greenhouse at rates of metals equivalent to those in 0 to 896 dry metric tons/ha of Washington, D.C., digested sewage sludge. The sludge was also applied at a rate of 224 dry metric tons/ha. Two pH regimes, approximately 5.5 and 6.5, were maintained. Metals were extracted by the DTPA (diethylenetriaminepentaacetic acid buffered at pH 7.3) or double acid (0.05N HCl, 0.025N H₂SO₄) extractants. Correlations were determined between extractable soil metals and metal content of two crops of corn (Zea mays L.) each grown for 30 days, but at times of 1 or 13 mo after making the chemical amendments to the soils. The results of the experiments were reported. (Skogerboe-Colorado State)
W79-05946

ZINC AND CADMIUM CONTENTS OF AGRICULTURAL SOILS AND CORN IN NORTH-WESTERN INDIANA

Metropolitan Sanitary District of Greater Chicago, IL. Research and Development Lab.
R. I. Pietz, R. J. Vetter, D. Masarik, and W. W. McPee.
Journal of Environmental Quality, Vol 7, No 3, p 381-385, July-September, 1978. 1 fig, 3 tab, 26 ref.

Descriptors: *Heavy metals, *Soil contamination, Environmental effects, Crop response, Zinc, Cadmium, Industrial plants, Urbanization, Corn.

Soil and corn (Zea mays L.) leaf and grain samplings were conducted in northwestern Indiana to determine if airborne heavy metal particulates containing Cd and Zn from the northwestern Indiana industrial-urban complex, situated on the south side of Lake Michigan, were contaminating soils and crops. Sampling in the region revealed no widespread metal contamination. Some metal enrichment had occurred on agricultural soils in Gary and East Gary, Indiana. Corn leaf concentrations of Cd, Pb, and Zn fluctuated with sampling location, but grain Cd and Pb levels remained essentially constant at < 0.05 and < 0.4 microgram/gram, respectively. A comparison of Zn/Cd ratios in soils, and in corn leaves and grain, suggested that Cd was more actively accumulated in the corn plant but not the grain. Because of the limited acreage affected and the relatively low metal levels observed, no human or animal health problems are expected from harvested crops or silage. The use of log distance vs. log metal concentration in regression analysis showed that the limited metal contamination of agricultural soils was mainly in a southeasterly direction from the industrial-urban area. (Skogerboe-Colorado State)
W79-05947

CHEMICAL, PHYSICAL, BIOCHEMICAL, AND BACTERIOLOGICAL CHARACTERISTICS AT SELECTED STREAM SITES IN PUERTO RICO, 1967-77

Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 7A.
W79-05967

INSTALLATION OF WATER- AND GAS-SAMPLING WELLS IN LOW-LEVEL RADIOACTIVE-WASTE BURIAL TRENCHES, WEST VALLEY, NEW YORK

Geological Survey, Albany, NY. Water Resources Div.
D. E. Prudic.
Geological Survey open-file report 78-718, 1978. 70 p, 22 fig, 3 tab, 5 ref.

Descriptors: *Water analysis, *Radioactive waste disposal, *Sites, *Sampling, Gases, Wells, Trenches, Analytical techniques, Water pollution, New York, Hand-augured wells, *West Valley (NY), *Cattaraugus County (NY), Radioactive-waste burial.

A low-level radioactive-waste burial site, West Valley, N.Y., operated from 1963 to 1975, contains 12 refuse-filled trenches about 20 feet deep in till. Twenty-eight wells, 1.25 inch in diameter, were driven to selected depths in 11 of the 12 trenches to obtain gas and water samples for chemical and radiochemical analysis, water-level measurements for evaluation of trench-cover permeability. Gas from unsaturated refuse above the trench water level was detected in nearly all wells. Rapid water-level response in most wells to pumping of water from trench sumps 20 to 275 feet distant showed the refuse to be highly permeable. Described in detail are the methods and equipment used to (1) install the wells, (2) collect gas and water samples, and (3) monitor radiation and methane concentrations while driving wells into trenches. A record of each well driven into the burial trenches is included. (Woodard-USGS)
W79-05970

GROUND-WATER QUALITY NEAR THE NORTHWEST 58TH STREET SOLID-WASTE DISPOSAL FACILITY, DADE COUNTY, FLORIDA

Geological Survey, Tallahassee, FL. Water Resources Div.
H. C. Matraw, J. E. Hull, and H. Klein.
Geological Survey Water-Resources Investigations 78-45, April 1978. 61 p, 28 fig, 10 tab, 16 ref.

Descriptors: *Landfills, *Solid wastes, *Leaching, *Path of pollutants, *Aquifer characteristics, Water quality, Leachate, Movement, Diffusion, Dispersion, Advection, Convection, Waste dilution, Rainfall, Infiltration, Florida, *Dade County, *Biscayne aquifer.

The Northwest 58th Street solid-waste disposal facility, 3 miles west of a major Dade County municipal water-supply well field, overlies the Biscayne aquifer, a permeable, solution-riddled limestone which transmits leachates eastward at a calculated rate of 2.9 feet per day. A discrete, identifiable leachate plume has been recognized under and downgradient from the waste disposal facility. Concentrations of sodium, ammonia, and dissolved solids decreased with depth beneath the disposal area and downgradient in response to an advective and convective dispersion. At a distance of about one-half downgradient, the rate of contribution of leachate from the source to the leading edge of the plume was about equal to the rate of loss of leachate from the leading edge of the plume by diffusion and dilution by rainfall infiltration during the period August 1973 - July 1975. Heavy metals and pesticides are filtered, adsorbed by aquifer materials, or are precipitated near the disposal area. (Woodard-USGS)
W79-05972

MODELING NITROGEN, OXYGEN, CHATTA-HOOCHIE RIVER, GA.,

Effects Of Pollution—Group 5C

Geological Survey, NSTL Station, MS. Water Resources Div.
J. E. Miller, and M. E. Jennings.
Preprint 3373 Presented at American Society of Civil Engineers Annual Meeting and Exposition, Chicago, Illinois, October 16-20, 1978. 18 p, 6 fig, 1 tab, 6 ref.

Descriptors: *Water quality, *Streams, *Model studies, *Nitrogen, *Dissolved oxygen, Analytical techniques, Flow control, Streamflow, Channel morphology, Effluents, Evaluation, Georgia, *Chattahoochee River, *Atlanta area.

During 1976 to 1977, the U.S. Geological Survey compiled four comprehensive sets of data, including streamflow, cross-section geometry, water quality, and waste effluent for a 67-mile reach of the upper Chattahoochee River near Atlanta, Ga. Using this data, steady and unsteady-state dissolved oxygen (DO) and nitrogen models were developed. Because reservoir releases from an upstream power reservoir were held to a fairly constant flow, the data form an excellent test case for steady-state dissolved oxygen and nitrogen model verification. The river was modeled utilizing all four data sets to calibrate and verify the USGS steady-state water-quality model (D. P. Bauer, M. E. Jennings, and J. E. Miller, written commun., 1978). A continuous record of DO was available from a DO monitor and some additional water-quality data for an unsteady flow period following a steady flow period was available from a DO monitor and some additional water-quality data for an unsteady flow period following a steady flow period was available within the reach; therefore, an unsteady-state model calculation (using parameters determined from the steady-state case but with rapidly varying streamflows) was run for comparison. The unsteady-state model used was developed by J. P. Bennett (written commun., 1978). (Woodward-Osgood)

W79-05974

EFFECTS OF LAND USE AND WATER MANAGEMENT ON WATER QUALITY IN THE WESTERN SOUTH NEW RIVER CANAL BASIN, SOUTHEAST FLORIDA, 1974-75, Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4C. W79-05978

5C. Effects Of Pollution

KINETIC PARAMETERS OF THE CONVERSION OF METHANE PRECURSORS TO METHANE IN A HYPEREUTROPHIC LAKE SEDIMENT, Michigan State Univ., East Lansing. Dept. of Microbiology.
R. F. Strayer, and J. M. Tiedje.
Applied and Environmental Microbiology, Vol. 36, No. 2, August 1978, p 330-340. 8 fig, 3 tab, 32 ref. NSF DEB 7606834.

Descriptors: *Kinetics, *Eutrophication, *Methane, *Hydrogen, *Acetate, *Wintergreen Lake (MI), *Sediments, *Michaelis-Menten equations, Michigan, Anaerobic conditions, Microorganisms, Lakes, Carbon dioxide, Tracers, Degradation (Decomposition), Carbon, Cycling nutrients, Nutrients, Formate.

The kinetic parameters $K_{sub m}$ (Michaelis-Menten constant), maximal velocity ($V_{sub max}$), turnover time ($T_{sub t}$), and natural velocity (v) were determined for hydrogen and acetate conversion to methane by microflora of anaerobic pelagic sediments in hypereutrophic Wintergreen Lake, Michigan, using short-term methods (a few hours) and incubation temperature of 10-14 C. $K_{sub m}$ estimates for both hydrogen consumption and conversion of hydrogen to methane by sediment microflora averaged 0.024 micromoles/g dry sediment. $V_{sub max}$ averaged 4.8 micromoles H₂/g/hr for hydrogen consumption and 0.64 micromol CH₄/g/hr for conversion of hydrogen to methane during winter. Use of the Michaelis-Menten equation and estimates of $K_{sub m}$, $V_{sub max}$, and dissolved oxygen concentration to estimate natural rates of hydrogen consumption and conversion to methane indicated methane may not be the only fate of hydrogen in the sediment. Of several potential hydrogen donors, only formate stimulated sediment methanogenesis. Formate conversion to methane was so rapid that it was impossible to accurately estimate kinetic parameters. Acetate apparently was being converted to methane at or near the maximal rate with sediments collected in summer. Preincubation of sediment with hydrogen had a pronounced effect of kinetic parameters for acetate to methane conversion. (Lynch-Wisconsin)

W79-05508

MAJOR PASSAGE PROBLEMS,

National Marine Fisheries Service, Seattle, WA. W. J. Ebel.

In: Columbia River Salmon and Steelhead, Schweibert, E., (Ed.). Proceedings of a Symposium, Vancouver, Washington, March 5-6, 1976. American Fisheries Society, Bethesda, MD 1977 p 33-39. 2 fig.

Descriptors: *Environmental effects, *Fish passages, Dams, Trout, Chinook salmon, Rivers, Snake River, Columbia River, Mortality.

This paper discusses the problems of survival of steelhead trout and chinook salmon stocks in the upper Snake River and the effect which the construction of dams along the Snake and Columbia Rivers has on this survival. Since 1969 adult return percentages of both species have declined at an alarming rate. This drop reflects losses of juveniles due to fish passage problems. The majority of these losses are attributed to turbines, supersaturation of water with nitrogen, delay in migration caused by impoundments, and an increase in predation. The average turbine mortality among migrating smolts is between 10 and 15%. Diversion screens have been developed and refined to the point where they are workable and can be used to divert fish from turbines adequately but future research will be centered on obtaining an optimum system. A collection and transport system is being investigated to determine the effects of transportation on homing and survival of juveniles. The data indicate that this system has been helpful in increasing the survival of both chinook and steelhead. (Chilton-ORNL)

W79-05509

CORPS OF ENGINEERS RESPONSIBILITIES AND ACTIONS TO MAINTAIN COLUMBIA BASIN ANADROMOUS FISH RUNS, Army Engineer District, Portland, OR. North Pacific Div.
E. M. Mains.

In: Columbia River Salmon and Steelhead, Schweibert, E., (Ed.). Proceedings of a Symposium, Vancouver, Washington, March 5-6, 1976. American Fisheries Society, Bethesda, MD., 1977. p 40-43.

Descriptors: *Environmental effects, *Fish passages, Trout, Chinook salmon, Research priorities, Columbia River, U.S. Army Corps of Engineers.

The Fish and Wildlife Coordination Act requires that the Corps of Engineers coordinate its water resource activities with the federal and state fish and wildlife agencies. Over the past 25 years, the Corps has funded a Fisheries-Engineering Research Program to collect information for use in construction and operation of fish facilities and projects. Research has identified primary problem areas as the loss of juvenile fish - in turbines, from water supersaturated with atmospheric gases in the spillways, increased predation, and perhaps the loss of migratory motivation due to impoundments. Spillway deflectors have been developed and installed to eliminate the problem of supersaturation with gases. A transport system has been developed. Future programs are aimed at providing assistance to fish runs of the Snake River drainage. (Chilton-ORNL)

W79-05510

THE MID-COLUMBIA PUBLIC UTILITY RESPONSIBILITY, Chelan County Public Utility District No. 1, Wenatchee, WA.
B. Leman.

In: Columbia River Salmon and Steelhead, Schweibert, E., (Ed.). Proceedings of a Symposium, Vancouver, Washington, March 5-6, 1976. American Fisheries Society, Bethesda, MD., 1977. p 44-50, 3 fig, 2 tab.

Descriptors: *Environmental effects, *Fish passages, Fish migration, Trout, Chinook salmon, Fish, Dams, Columbia River, Snake River.

The two principal factors in the fish passage problem in the Columbia watershed are identified as supersaturated gas in the river spillage downstream of dams, and turbine mortality to downstream migrants. The Northwest Utilities Combine sponsored research which indicated that fish retained in a free-volition cage in a reservoir suffered no mortality in 20 days, while exposed to gas concentrations of 119 to 128% saturation. It was also found that 90% of the live test specimens exhibiting extreme gas-bubble disease symptoms, after being held at depths of one meter or less, recovered in a cage placed at a depth of 3-4 meters. Descaling of fish from impingement on traveling intake screens and dermal abrasions from bypass system walls present serious problems. It is stated that spilling water during downstream migration has been verified as a workable means of passing migrants downstream. The problem with this method is the critical shortage of energy to meet the existing peak demand. Field studies toward the solution of these problems are underway. (Chilton-ORNL)

W79-05511

THE IMPORTANCE OF WATER QUALITY TO COLUMBIA RIVER SALMON AND STEELHEAD,

Corvallis Environmental Research Lab., OR.
G. R. Bouck.

In: Columbia River Salmon and Steelhead, Schweibert, E., (Ed.). Proceedings of a Symposium, Vancouver, Washington March 5-6, 1976. American Fisheries Society, Bethesda, MD., 1977. p 149-154, 15 ref.

Descriptors: *Water quality, *Environmental effects, Columbia River, Fish, Trout, Chinook salmon, Temperature, Heavy metals, Gases, Water quality standards.

In this discussion of the importance of water quality it is pointed out that no other single parameter has such a determining effect on a fishery as does water temperature. Temperature has a major impact on metabolic rates so that increased temperatures can result in increased weight loss during migration. Metabolic wear and tear caused by high temperature also has an adverse effect on primary sexual development in sockeye salmon. Juvenile salmon and steelhead have difficulty making the parr-smolt transformation at temperatures above 13C. Heavy metals are mined at several locations in the Columbia River basin and the toxic effects of these are discussed. Nitrogen supersaturation which was reported elsewhere in the symposium is touched upon. (Chilton-ORNL)

W79-05512

WORKSHOP ON COPPER IN ESTUARINE, CONTINENTAL AND MARINE WATERS,

Available from the National Technical Information Service, Springfield, VA 22161 as CONF 771236. Price codes: A03 in paper copy, A01 in microfiche. CONF-771236. Proceedings of a Workshop December 7-8, 1977. San Francisco, California, April 1978 36 p.

Descriptors: *Conferences, *Environmental effects, *Copper, Aquatic environment, Estuarine environment, Sea water.

This publication is the summary of a workshop which was held following the fall meeting of the American Geophysical Union, 1977. The purpose of the workshop was to discuss the state of knowl-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

edge, evaluate present research, and to provide emphasis for future direction of research on the subject of the workshop. The workshop consisted of four major topic areas (Analytical and Sampling Techniques, Copper/Ecosystems Interactions, Biological Availability, and Biological Uptake and Effects) each of which is reported upon in this summary publication. This report also includes abstracts of the papers presented in the AGU sessions. (Chilton-ORNL)
W79-05513

ECOLOGICAL BIOENERGETICS OF *PHYSA ACUTA* (GASTROPODA) IN HEATED WATERS

Polish Academy of Sciences, Warsaw Lab. of Ecological Bioenergetics.
E. Kamler, and W. Mandacki.
Polskie Archiwum Hydrobiologii, Vol. 25, No. 4, p 833-868 1978. 12 fig, 8 tab, 64 ref.

Descriptors: *Environmental effects, *Thermal pollution, Heated waters, Snails, Energy budget, Productivity, Respiration, Reproduction.

Detailed studies of assimilation of *P. acuta* carried out, and the food consumption level was evaluated in two laboratory populations bred at 22 and 26°C, respectively, under optimal nutritional conditions. The elements of this energy budget are described in the paper by 18 algebraic equations. During the whole life cycle of 260 and 203 days, respectively, total production cumulated was 390.9 and 366.3 cal/individual. Egg production was very high. The effect of high reproductive activity on respiration was discussed. By two calculation methods it was shown that the oxygen consumption level was higher than it was predicted from body production. Comparison of measured assimilation value with field density data indicate that *P. acuta* can effectively eliminate organic matter deposited in heated reservoirs and can serve as fish food. (Chilton-ORNL)
W79-05514

THE RECOVERY AND HEMATOLOGICAL REHABILITATION OF CHLORINE STRESSED ADULT RAINBOW TROUT (*SALMO GAIRDNERI*)

Consumers Power Co., Jackson, MI. Dept. of Environmental Services.
I. H. Zeitoun.
Environmental Biology of Fishes Vol. 3, No. 4, p 355-359 1978, 3 tab, 24 ref.

Descriptors: *Environmental effects, *Chlorination, Powerplants, Fish, Rainbow trout, Mortality, Resistance, Physiology, Toxicology.

Six separate test were conducted to test the ability of adult rainbow trout to recover from acute chlorine exposure. Blood was collected before the tests (control group), at the appearance of chlorine distress symptoms, and at 24 and 48 hours after exposures. Total residual chlorine (TRC) concentrations were 1.67, 3.50, 1.10, 1.25, 1.02, and 0.0 mg/l at water temperatures of 13.5, 14.6, 17.2, 22.6, 23.0, and 26.0 C, respectively. At 48 hours after exposure, fish mortality was 11.5, 100, 0.0, 67.1, 36.1 and 100%. Blood of chlorine stressed fish showed signs of hemoconcentration and hemolysis. During recovery in chlorine-free water, all measured blood parameters returned to the control level within 24 hours with the exception of plasma hemolysis which was restored to control level within 48 hours. TRC concentrations of 3.5 mg/l at 14.0 C and 1.25 and 1.02 mg/l at 23 C significantly diminished recovery. It was concluded that chlorine induced stress does not necessarily lead to fish death and fish do recover successfully. (Chilton-ORNL)
W79-05515

ENTRAINMENT IMPACT ESTIMATES USING THE EQUIVALENT ADULT APPROACH

National Power Plant Team, Ann Arbor, MI.
C. P. Goodyear.
For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C.

20402. Fish and Wildlife Service Report FWS/OBS-78/65, July 1978, 14 p. 2 fig, 4 tab, 5 ref.

Descriptors: *Environmental effects, *Entrainment, *Model studies, Fish, Forecasting, Mortality.

One approach to assessing the importance of entrainment mortality of eggs and larvae of fish and shellfish by power plants is to estimate the number of adult organisms which this loss represents. The limitations of this model which could lead to underestimates of the actual impact are discussed and an alternative formulation is presented which is designed to reduce the bias. The approach is expanded to provide estimates of numbers of fish caught by fishermen. (Chilton-ORNL)
W79-05516

IMPORTANCE OF ALGAE IN THE DIET OF THE OLIGOCHAETES *LUMBRICULUS VARIEGATUS* (MULLER) AND *RHYACODRILUS SODALIS* (EISEN)

Canada Environmental Protection Service, Yellowknife (Northwest Territories).
J. W. Moore.

Oecologia, Vol. 35, No. 3, 1978, p 357-363. 2 fig, 1 tab, 26 ref.

Descriptors: *Algae, *Food habits, *Oligochaetes, *Lumbriculus variegatus, *Rhyacodrilus sodalis, *Great Slave Lake (Northwest Territories, Canada), Eutrophication, Bays, Canada, Northwest Territories (Canada), Lakes, Detritus, Bacteria, Seasonal, Feeding rates, Annelids, Cold regions, Size, Nostoc, Cymatopleura elliptica, Cymbella, Epithemia turgida, Pinnularia, Synedra ulna, Abundance.

Analysis of gut contents of the oligochaetes *Lumbriculus variegatus* and *Rhyacodrilus sodalis* collected 1977-78 in a shallow, eutrophic bay in northern Great Slave Lake (Canadian subarctic) showed algae is very important in their diet, contrary to previous studies of deep, freshwater oligochaete populations in which food consisted almost exclusively of bacteria. In this study, during summer when algae were abundant they made up 70-85% of gut contents of the two species, whereas in winter when algal densities were low, detritus and associated bacteria became the major food source, and volume of food eaten decreased greatly. Total volume of gut contents in 35-50 mm specimens ranged from 1-2 cu mm in winter to 4.5 cu mm in May and 5.5 cu mm in June. All species of unicellular algae were consumed in proportion to their abundance in the environment, though size selection prohibited consumption of the very large colonies (over five mm diameter) of *Nostoc prunifforme* and *N. verrucosum*. Food availability rather than temperature was the major factor influencing algal consumption; although intensive feeding began as soon as temperatures rose above 0C in May, the rise in quantity of ingested algae was delayed until epipellic populations expanded in June. Most frequently ingested species were *Cymatopleura elliptica*, *Cymbella* spp., *Epithemia turgida*, *Pinnularia* spp., and *Synedra ulna*. (Lynch-Wisconsin)
W79-05517

EVALUATION OF PROPOSED TG AND E (TUCSON GAS AND ELECTRIC COMPANY) WASTEWATER DISCHARGE ON GROUNDWATER IN THE TUCSON BASIN

Ground-Water Quality Consultant, Fresno, CA.
For primary bibliographic entry see Field 5E.
W79-05519

CHEMICAL AND MICROBIOLOGICAL CHARACTERISTICS OF TWO, RECREATION ORIENTED, OLIGOTROPHIC MOUNTAIN LAKES

Arizona State Univ. Tempe.
S. M. Oakley, B. A. Segal, and R. M. Johnson.
Journal of the Arizona-Nevada Academy of Science, Vol. 12, No. 1, p 36-46, Feb. 1977. 6 fig, 12 tab, 18 ref.

Descriptors: *Lakes, *Oligotrophy, *Chemical properties, *Arizona, *Recreation wastes, *Pollutant identification, *Eutrophication, *Microbial degradation, *Limnology, Recreation facilities, Sampling, Water pollution source, Water quality, Biochemistry, Coliforms, Marine bacteria, Lake morphology, Lake stages.

The acceptable chemical and microbial conditions of a lake must be known early, to facilitate the detection of water quality changes as a lake experiences gross pollution and eutrophication from various types and levels of recreational use. The purpose of this study was to outline the microbiological and chemical properties of two relatively pristine lakes in Arizona, the Woods Canyon and the Bear Canyon lakes, to facilitate the detection of pollution brought about by recreational use. Both lakes are approximately the same size although Woods Canyon Lake, the more easily accessible of the two, was visited by 204,900 persons in 1974 while Bear Canyon Lake was visited by 47,700 people during the same period. Total bacterial counts were made from May through October on a medium with conditions similar to those extant in the lakes, and coliform and fecal streptococci bacteria were enumerated along with attempts to isolate specialized bacteria associated with geochemical cycles. Samples were obtained from the sites from May to August and analyzed according to standard methods. Results indicated that while both lakes are subjected to varying degrees of human use at the present time, all bacterial parameters studied indicate that both lakes are able to recover at this time from the current human use and that some increase in use at Bear Canyon Lake would not be harmful. (Tickes-Arizona)
W79-05564

CULTIVATING AND HARVESTING ALGAE TO FORESTALL ACCELERATED EUTROPHICATION

Rhode Island Univ., Kingston. Graduate School of Oceanography.
N. Marshall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 019, Price codes: A03 in paper copy, A01 in microfiche. *Water Resources Center, University of Rhode Island, Completion Report, 1979. 47 p, 27 fig, 10 tab, 13 ref. OWRT A-065-R1(1), 14-34-0001-8042.

Descriptors: Ulva, Gracilaria, Ammonia uptake, Sewage treatment, *Eutrophication, *Harvesting of algae, Nitrogen.

The effects of a variety of light, ammonia and water motion regimes on the growth and carbon and nitrogen composition of the marine macroalgae *Ulva lactuca* and *Gracilaria tikvahiae* were tested by laboratory experimentation. Rates of ammonia uptake were also observed during the experiments. In almost every experiment a low level of simulated current enhanced algal growth and ammonia uptake rates but the current effect soon reached a plateau beyond 7.5 cm sec⁻¹. Total ammonia uptake and algal tissue nitrogen were positively correlated with ammonia concentration. Variations related to levels of all factors tested are reported in detail. Growth of these species was also tested in the field, including in a cove which received considerable sewage input and high ammonia loading. Based on growth observations in this environment and laboratory nitrogen incorporation in high ammonia concentrations, it is concluded that cultivation of these species near sewage outfalls in marine coves could remove a significant portion of the excess nitrogen on a seasonal basis.
W79-05584

ECOLOGICAL STUDIES OF THE ANNUAL RED ALGA *DUMONTIA NCRASSATA* (O.F. MULLER) LAMOUROUX

New Hampshire Univ., Durham. Dept. of Botany and Plant Pathology.
J. A. Kilar, and A. C. Mathieson.
Botanica Marina, Vol. 21, No. 7, p 423-437, October 1978. 24 fig, 2 tab, 44 ref.

Effects Of Pollution—Group 5C

Descriptors: **Dumontia incrassata*, *Seasonal, *Reproduction, *Ecology, *Phenology, *Tidal pools, *Algae, *Rhodophyta, *Marine algae, *New Hampshire, *Jaffrey Point(NH), *Dover Point(NH), *Spores, *Periodicity, *Gametophytes, *Biomass, *Plant growth, *Growth stages, *Nutrients, *Atlantic Ocean, *Estuaries, *Abundance, *Habitats, *Tetraspores, *New England.

Seasonal growth and reproduction of the red alga *Dumontia incrassata* studied at two sites on the New Hampshire coast (Dover Point and Jarrey Point) were greatest during the winter-spring period of low temperatures (less than 10°C) and at high nutrient levels. Gametophytic generations were more restricted in seasonal periodicity than asexual plants. Tetrasporic plants were dominant despite a 1:1 ratio of asexual to sexual plants. Spores were liberated in spring and summer and germinated in fall. Reproduction began during the period of maximum stature; the largest plants and greatest number of gametophytic plants occurred in March. However, maximum biomass, associated with development of mature tetraspores and carpogones on the thallus, occurred in April and thus did not coincide with maximum stature. Maximum reproduction accompanied declining growth, unlike such other seaweeds as *Gigartina stellata* and *Codium fragile*. Differences in habitat and winter conditions strongly affected the phenology of *D. incrassata*, with greatest reproductive differences observed in the highest pool. The study was conducted March 1976-February 1977, with water characteristics recorded at Jaffrey Point, New Castle, and Dover Point, and *D. incrassata* studied at two tidal pools at Jaffrey Point and in a series of estuarine depressions at Dover Point. (Lynch-Wisconsin)

W79-05618

ECO-BIOCHEMICAL STUDIES ON SOME ECONOMICALLY IMPORTANT INTERTIDAL ALGAE FROM PORT OKHA (INDIA), Saurashtra Univ., Rajkot (India). Dept. of Biosciences. M. S. Murthy, and P. Radia. *Botanica Marina*, Vol. 21, No. 7, p 417-422 October 1978.

Descriptors: *Okha(India), *Ulva lactuca, *Gelidium acerosa, *Sargassum swartzii, *Algae, *Biochemistry, *Ecology, *Commercial algae harvesting, India, Intertidal areas, Nitrogen, Fats, Carbohydrates, Proteins, Sodium, Potassium, Calcium, Phosphorus, Chemical analysis, Seasonal, Arabian Sea, Gulf of Kutch(India), Fertilizers, Foods.

Biochemical content of the intertidal algae *Ulva lactuca* (Chlorophyceae), *Gelidium acerosa* (Rhodophyceae), and *Sargassum swartzii* (Phaeophyceae) from the coast at Port Okha on the Gulf of Kutch (Arabian Sea), Gujarat State, India was correlated with ecological factors of the marine environment. Results showed: (1) close relationship between net primary productivity and protein content in *S. swartzii*; (2) inverse relationship between crude fat and crude fiber content in all three algae; (3) temperature, salinity, and pH had no effect on biochemical content of the algae; and (4) water deficiency resulting from increased exposure and consequent increased light enhanced fat formation in *S. swartzii* and *G. acerosa*. The three algae, all of present or potential importance for food, fodder or fertilizer were studied during one growing season from June-February (except *U. lactuca*, studied from September). Total nitrogen, crude protein, carbohydrates, sodium, potassium, calcium, and phosphorus were determined for the algal material, and seawater was analyzed for temperature, pH, salinity, sodium, potassium, calcium, and phosphorus. In general, algal and seawater content of sodium, potassium, calcium, and phosphorus, showed peaks in June and October, comparatively lower values in December and January, and a sharp rise in February. Algal protein content showed great fluctuations from month to month. (Lynch-Wisconsin)

W79-05630

PATTERNS OF ALGAL SUCCESSION IN A PERTURBED MARINE INTERTIDAL COMMUNITY, California State Univ., Fullerton. Dept. of Biological Science.

S. N. Murray, and M. M. Littler. *Journal of Phycology*, Vol. 14, p 506-512, 1978. 2 fig, 4 tab, 29 ref. (California Water Resources Center Project UCAL-WRC-W-491). OWRT A-054-CAL(8).

Descriptors: *Aquatic algae, *Succession, *Biological communities, *Environmental effects, *Intertidal areas, *Sewage, *Water pollution, *Water pollution effects, *Marine algae, *Marine microorganisms, *Microenvironment.

Patterns of algal succession for a sewage-polluted and an unpolluted habitat near Wilson Cove, San Clemente Island, California, were studied from December 1974 to June 1977. Resident populations were analyzed for 36 fully denuded and 34 undisturbed control quadrats during 11 assessment periods. The denuded quadrats in the perturbed (polluted) habitat showed recovery within 1.0 mo as determined by cover, percent similarity and species diversity comparisons with control plots. The short recovery times of the algal populations dominating the perturbed habitat indicate that these species maintain relatively constant overall abundances due to their potential for rapid recruitment and growth. Denuded quadrats in an unpolluted habitat did not show recovery even after 30.0 mo. These quadrats were dominated during the first 1.3 mo by algae characteristic of the perturbed area, including filamentous Ectocarpaceae, colonial diatoms and bluegreen algae. The similarity between the species occupying the sterilized plots during the first few months and those that provide the majority of cover in the perturbed area supports the hypothesis that the dominant algae of the upper and mid-intertidal regions of this habitat consist largely of early successional or opportunistic species with high capacities for growth and reproduction. Additionally, these experiments suggest that algal populations described for other perturbed epilithic systems also represent resilient subclimax associations. (Snyder-Calif., Davis)

W79-05664

BASELINE CHARACTERIZATION OF MARINE MAMMALS IN THE BERING SEA: DISTRIBUTION AND ABUNDANCE, National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.

H. W. Braham, and D. Rugh. IN: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors-Mammals-Birds, p 1-14, October 1978. 1 fig, 1 tab, 25 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Baseline studies, *Environmental effects, *Alaska, *Mammals, *Water pollution effects, *Migration, *Temporal distribution, *Spatial distribution, *Abundance, *Outer Continental Shelf, *Ecological distribution, *Whales, *Gray whales, *Sea lions, *Eumetopias jubatus, *Eschrichtius robustus, *Bering Sea.

Final analysis of the northern sea lion (*Eumetopias jubatus*) data confirmed earlier diagnosis that a 30% decline in the population has occurred in the eastern Aleutian Islands study area since the late 1950's and early 1960's. Data on the fall migration of the California gray whale (*Eschrichtius robustus*) were compiled. Results showed that about 75% of the population leaves the Bering Sea through Unimak Pass during the last two weeks of November and the first week of December. (Sinha-OEIS)

W79-05665

SEASONAL DISTRIBUTION AND RELATIVE ABUNDANCE OF MARINE MAMMALS IN THE GULF OF ALASKA, National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.

H. W. Braham, and R. W. Mercer.

IN: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors-Mammals-Birds, p 15-28, October 1978. 3 fig, 2 tab, 22 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, CO., R7120306.

Descriptors: *Baseline studies, *Environmental effects, *Alaska, *Mammals, *Water pollution effects, *Migration, *Abundance, *Temporal distribution, *Oil pollution, *Resources development, *Outer Continental Shelf, *Ecological distribution, *Gulf of Alaska.

Dall porpoises migrate across the Kodiak and Northeast GOA oil lease sites, apparently in greatest numbers in the spring (especially May). Preliminary plots indicate that Prince William Sound is an important summering area, however the Kodiak Island oil lease area also appears to be of as yet undetermined importance during the summer. The location of greatest concentration from June through August is Unimak Pass and along the continental edge in the southern Bering Sea. Whether these animals are migrants from the GOA or the western North Pacific Ocean is unknown. California gray whales twice migrate through six oil lease tracts in Alaska each year. Preliminary evidence indicate that up to 75% of the population moves by Unimak Pass, and perhaps Kodiak Island, during a three week period in the fall. Any adverse effects on gray whales resulting from oil-gas development would be accentuated during this period of animal concentration. (Sinha-OEIS)

W79-05666

SEASONAL DISTRIBUTION AND ABUNDANCE OF BOWHEAD AND BELUGA WHALES IN THE BERING SEA AND ARCTIC OCEAN, National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.

H. W. Braham, and B. D. Krogman. IN: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors-Mammals-Birds, p 29-38, October 1978. 1 tab, 1 ref. NOAA Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Baseline studies, *Temporal distribution, *Spatial distribution, *Mammals, *Alaska, *Computer programs, *Environmental effects, *Resources development, *Arctic Ocean, *Outer Continental Shelf, *Whales, *Beluga whales, *Bowhead whales, *Bering Sea.

Field data were analyzed to identify bias in sampling techniques. Poor visibility conditions do not constitute a significant negative bias which must be adjusted. Data are too scant to conclude that lead width greatly influences rates of whale movements by Barrow during the spring sampling period. A computer format is partially presented as a medium for analysis and storage of whale survey data collected from fixed stations. The ice camp index is evaluated as a measure of total population abundance, and components of the bowhead population are categorized as related to the index. (Sinha-OEIS)

W79-05667

MORBIDITY AND MORTALITY OF MARINE MAMMALS, Alaska Univ., Fairbanks. Inst. of Marine Science; and Alaska Univ., Fairbanks. Inst. of Arctic Biology.

F. H. Fay, R. A. Dieterich, L. M. Shultz, and B. P. Kelly.

IN: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors-Mammals-Birds, p 39-79, October 1978. 2 fig, 5 tab, 65 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-56.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

Descriptors: *Baseline studies, *Pathology, *Water pollution effects, *Mammals, *Environmental effects, *Morbidity, *Mortality, *Ecosystems, *Resources development, *Alaska, *Outer Continental Shelf, *Gulf of Alaska, *Bering Sea.

The common pathological conditions and their causes in marine mammals of the Bering Sea and Gulf of Alaska - Cook Inlet region are identified. Because they are highly visible and are the main top level consumers in the marine system, marine mammals may provide the best, most easily assessed index of the 'health' of the marine system as a whole. Present knowledge of the morbidity/mortality factors affecting species inhabiting the Alaskan shelf water is summarized. Predation and parasitism seem to be the principal causes of natural illness and death, followed closely by malnutrition. Investigations in the past year have centered on necropsy of samples drawn from the living populations in the eastern Bering Sea and Gulf of Alaska. In the 96 collected specimens examined, the most frequently occurring gross pathological conditions were: (1) hepatitis, probably of helminthic origin; (2) pneumonia, also principally caused by helminths; (3) dermatitis, of fungal, bacterial, and possibly viral origin; (4) wounds, from various causes; and (5) gastric ulcers caused by parasitic invasions. Parasites and microbiological infections seem often to be sufficiently debilitating to predispose these animals to predation. (Sinha-OEIS)

W79-05668

BIOLOGY OF THE HARBOR SEAL, PHOCA VITULINA RICHARDI, IN THE GULF OF ALASKA

Alaska Dept. of Fish and Game, Anchorage. K. Pitcher, and D. Calkins.

In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors-Mammals-Birds, p 80-98, October 1978. 3 fig, 12 tab, 3 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-69.

Descriptors: *Baseline studies, *Mammals, *Life history studies, *Ecology, *Oil pollution, *Water pollution effects, *Resources development, *Environmental effects, *Outer Continental Shelf, *Gulf of Alaska, *Seals, *Harbor seals, *Petroleum, *Phoca vitulina richardi.

Four collecting trips were completed during calendar year 1977 resulting in the taking of 125 harbor seals to study the life history of the harbor seal in the Gulf of Alaska. Exploration, development and transportation of petroleum reserves in the Gulf of Alaska have a number of potential harmful effects on harbor seal populations. Some of the more obvious include the following: (1) direct injury to animals through contact with or ingestion of oil (this may result directly in death of the individuals involved or could result in lowered physical condition which in turn might alter long term survival and biological processes such as growth and reproduction), (2) disturbance, particularly during vulnerable stages of their life cycle such as pupping and molting, (3) reduction of productivity of the marine system by contamination, (4) direct mortality of important prey species by contact with oil and (5) increased levels of environmental contaminants. This project was designed to collect information to aid in the decision making process for gas and oil development in the Gulf of Alaska. Data gathered will enable development of guidelines for all stages of the OCS development program which will reduce harmful effects on harbor seal populations. Predevelopment data are being collected so changes which might occur can be detected. (Sinha-OEIS)

W79-05669

THE NATURAL HISTORY AND ECOLOGY OF THE BEARDED SEAL (ERIGNATHUS BARBATUS) AND THE RINGED SEAL (PHOCA HISPIDA)

Alaska Dept. of Fish and Game, Fairbanks. J. J. Burns, and T. J. Eley.

In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors-Mammals-Birds, p 99-160, October 1978. 17 tab, 135 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 02-5-022-53.

Descriptors: *Ecology, *Life history studies, *Baseline studies, *Resources development, *Oil pollution, *Water pollution effects, *Environmental effects, *Alaska, *Mammals, *Outer Continental Shelf, *Bering Sea, *Beaufort Sea, *Shukchi Sea, *Bearded seal, *Ringed seal, *Erignathus barbatus, *Phoca hispida.

Ringed seals, *Phoca hispida*, and bearded seals, *Erignathus barbatus*, are major components of the marine mammal fauna of the Bering, Chukchi, and Beaufort Seas. They have been chosen as target species for investigation based upon criteria including their significance in the ecosystem, importance to people residing along the coast, and considerations of timeliness, feasibility, and applicability to OCS requirements. The ringed seal is a small, widely distributed and very abundant species which mainly occurs in areas of extensive, relatively thick and stable sea ice. In marked contrast, bearded seals are the largest of the northern seals. They are also widely distributed, but occur in the drifting ice. They feed almost exclusively on benthic organisms. Proposed OCS lease areas in the Bering, Chukchi, and Beaufort Seas are within the habitat of these seal species and pose a real threat to their populations. The objectives of the studies are to develop a baseline of ecological and behavioral data in order to prevent to lessen adverse impacts of outer continental shelf development. (Sinha-OEIS)

W79-05670

TROPHIC RELATIONSHIPS AMONG ICE INHABITING PHOCID SEALS

Alaska Dept. of Fish and Game, Fairbanks.

L. F. Lowry, K. J. Frost, and J. J. Burns.

In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors-Mammals-Birds, p 161-365, October 1978. 5 fig, 31 tab, 62 ref, 2 append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-53.

Descriptors: *Mammals, *Ice, *Ecology, *Habitats, *Baseline studies, *Environmental effects, *Resources development, *Life history studies, *Water pollution effects, *Alaska, *Outer Continental Shelf, *Trophic relationships, *Food habits, *Bering Sea, *Beaufort Sea, *Chukchi Sea, *Petroleum.

Ice inhabiting seals are highly visible, numerous, sociologically and economically important species in the Bering-Chukchi and Beaufort marine ecosystems. A complete understanding of the role of these seals in the trophic structure of these ecosystems is crucial to the evaluation of potential impacts of OCS development. Key areas and times of foraging must be determined and will have direct bearing on the suitability of various areas for leasing. When key prey species have been identified and data correlated with information on the distribution, abundance and natural history of these prey species (from other projects), an evaluation of effects of OCS development on the food base of the seals can be made. By understanding the trophic relationships among ice inhabiting seals and other consumers in the system, indirect effects of OCS development (e.g. those favoring population increase of potential food resource competitors) can be predicted. It appears that ringed seals feed primarily on benthic invertebrates and fishes, spotted seals eat pelagic and demersal fishes and crustaceans, and ribbon seals consume fishes, cephalopods and shrimp. A total of 689 specimens are included in this report, approximately double the number reported on in 1977. Results are presented by locality and time of year within four major geographical areas: southeastern Bering Sea, northern Bering Sea, Chukchi Sea and Beaufort Sea. General feeding patterns are discussed for each species in each area. A brief evaluation of geo-

graphical, temporal and age- and sex-related dietary differences is made. (Sinha-OEIS)

W79-05671

AN AMENDMENT TO RU232 TROPHIC RELATIONSHIPS AMONG ICE INHABITING PHOCID SEALS, AND RU230 NATURAL HISTORY OF RINGED AND BEARDED SEALS, Alaska Univ., Fairbanks. Inst. of Marine Science; and Alaska Univ., Fairbanks. Inst. of Arctic Biology.

F. H. Fay, and L. M. Shults.

In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors-Mammals-Birds, p 366-372, October 1978. 2 tab, 6 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Baseline studies, *Mammals, *Pathology, *Ecology, *Ice, *Resources development, *Water pollution effects, *Heavy metals, *Pesticides, *Oil pollution, *Environmental effects, *Alaska, *Outer Continental Shelf, *Beaufort Sea, *Seals, *Food habits, *Phoca hispida, *Erignathus barbatus.

Marine mammals are the only resident top level consumers in the Beaufort Sea ecosystem. Because of this, their health and welfare, is indicative of the 'health' of the marine ecosystem itself, since they are the ultimate recipients of all changes that take place within the system, from perturbation and pollution to simple physical disturbance. Because they tend to be long-lived, they can provide a cumulative historical record of past conditions, e.g., in their overall growth and the growth of certain body parts, and in their stores of certain pollutants, such as heavy metals and pesticides. They also are responsive to short-term changes, which are reflected in their migrations, nutrition, and reproduction. The objective of this study was to provide baseline information on the kinds and rates of occurrence of natural pathological conditions and their causative agents in the living populations of bearded and ringed seals of the Beaufort Sea. Necropsies were performed on 16 ringed seals, *Phoca hispida*, and 5 bearded seals, *Erignathus barbatus*, collected during the multidisciplinary research cruise of the USCGC Glacier in the Beaufort Sea during August and September 1977. Each of these pinnipeds was found to have several kinds of endoparasitic helminths and about half of them exhibited pathological conditions in the liver. (Sinha-OEIS)

W79-05672

POPULATION ASSESSMENT, ECOLOGY AND TROPHIC RELATIONSHIPS OF STELLER SEA LIONS IN THE GULF OF ALASKA

Alaska Dept. of Fish and Game, Anchorage. D. Calkins, and K. Pitcher.

In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors-Mammals-Birds, p 373-413, October 1978. 6 fig, 13 tab, 6 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-69.

Descriptors: *Mammals, *Ecology, *Life history studies, *Abundance, *Distribution, *Resources development, *Water pollution effects, *Environmental effects, *Oil pollution, *Alaska, *Outer Continental Shelf, *Gulf of Alaska, *Trophic relationships, *Population assessment, *Steller sea lions, *Eumetopias jubatus, *Delphinapterus leucus, *Enhydra lutris.

Population dynamics, life history and some aspects of the ecology of the Steller sea lion (*Eumetopias jubatus*) were studied. In addition to the sea lion investigations, an examination of the distribution and abundance of belukha whales (*Delphinapterus leucus*) in Cook Inlet and the distribution and abundance of sea otters (*Enhydra lutris*) near the south end of the Kodiak Archipelago were also studied. The basic objectives of the sea lion work are to provide information on population status, seasonal distribution, movement patterns, population composition and segregation, use of critical

Effects Of Pollution—Group 5C

habitats, food habits, reproductive biology and productivity. Other objectives include collection of information on growth, pathology and environmental contaminant loads. Objectives of the belukha work are to gather information on seasonal distribution, and abundance and use of critical habitats; to test practicality of survey methods and to supply information which can be used to design a research project on this population. The sea otter work is to provide information on the distribution of sea otters in the area between Kodiak Island and Chirikof Island, to identify specific areas critical to these sea otters and to determine the extent of repopulation in this former sea otter habitat. This study has been designed to examine the potential impacts associated with exploration for, development of and transportation of crude oil and natural gas reserves in the Gulf of Alaska. All three species studied are vulnerable to Outer Continental Shelf oil and gas development through direct contact and contamination, indirect contamination of food sources or habitat, and disturbance generated by exploration activities. (Sinha-OEIS) W79-05673

A SURVEY OF CETACEANS OF PRINCE WILLIAM SOUND AND ADJACENT VICINITY - THEIR NUMBERS AND SEASONAL MOVEMENTS

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services; and National Marine Fisheries Services, Seattle, WA.
J. D. Hall, and J. H. Johnson.

In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors—Mammals—Birds, p 414-426, October 1978. 1 tab, 10 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, CO. 01-6-022-15670.

Descriptors: *Baseline studies, *Abundance, *Temporal distribution, *Mammals, Water pollution effects, Oil spills, Environmental effects, Alaska, *Outer Continental Shelf, *Cetaceans, Feeding habits, Petroleum transport, Prince William Sound, Gulf of Alaska, Porpoises.

Basic objectives of this first year of a planned three-year project are to document the relative numbers and seasonal distribution of cetaceans in Prince William Sound, Alaska, and to determine major foraging and accumulation areas for principal species. The results presented in this report represent part of the effort by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Alaska Department of Fish and Game to obtain baseline resource data from outer continental shelf areas in Alaska to evaluate the probable impacts on natural resources from development of petroleum reserves. Of more general importance than the effect of oil spills on cetaceans is the likelihood of disturbance to cetacean populations by exploratory and development activity in the lease areas and from or by marine petroleum transport corridors, such as Hinchinbrook Entrance and the port of Valdez. (Sinha-OEIS) W79-05674

IDENTIFICATION, DOCUMENTATION AND DELINEATION OF COASTAL MIGRATORY BIRD HABITAT IN ALASKA

Alaska Dept. of Fish and Game, Anchorage.
P. D. Arneson.

In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors—Mammals—Birds, p 431-481, October 1978. 10 fig, 12 tab, 8 ref, 3 append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, CO. 03-5-022-69.

Descriptors: *Birds, *Migratory birds, *Oil spills, *Water pollution effects, Baseline studies, Environmental effects, Alaska, Resources development, Habitats, *Outer Continental Shelf, Feeding habits, Bristol Bay, Cook Inlet, Petroleum transport.

Marine birds annually congregate in large numbers along the coast of Alaska. For the past two and

one half years, the overall objective of this project was to quantify the seasonal distribution of birds in coastal habitats. A second objective was to determine which areas or habitats are critical to the welfare of marine birds. Studies for the current reporting period were confined to Bristol Bay and Lower Cook Inlet. The world's population of the dark-color phase Brant and most of the world's population of Emperor Geese use the north side of the Alaska Peninsula during migration. An untimely, catastrophic spill could destroy both populations either directly or through habitat destruction. Both dabbling ducks and shorebirds would most be affected in the event of an oil spill by destruction of food organisms in intertidal and supratidal areas. Based on this winter's surveys only, it appears as if few wintering birds would be affected by oil spills or development in the middle or western sides of Lower Cook Inlet. If oil were spilled during winter months and deposited in Kamishak Bay, it may affect birds indirectly in other seasons by destroying their food organisms. (Sinha-OEIS) W79-05675

IDENTIFICATION, DOCUMENTATION AND DELINEATION OF COASTAL MIGRATORY BIRD HABITAT IN ALASKA. I: BREEDING BIRD USE OF BARRIER ISLANDS IN THE NORTHERN CHUKCHI AND BEAUFORT SEAS

Point Reyes Bird Observatory, Stinson Beach, CA.
G. J. Divoky.

In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors—Mammals—Birds, p 482-548, October 1978. 35 fig, 2 tab, 18 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-69.

Descriptors: *Migratory birds, *Habitats, *Alaska, *Breeding, Resources development, Baseline studies, Environmental effects, Water pollution effects, *Outer Continental Shelf, Beaufort Sea, Chukchi Sea, Petroleum transport.

Between Cape Lisburne and Demarcation Point there are over 60 barrier islands and spits in the nearshore waters of the Chukchi and Beaufort seas. These islands and spits provide a unique seabird nesting habitat that is not found elsewhere in the state of Alaska. Because the islands offer ideal platforms for drilling rigs and causeways, the exploitation of oil and gas from beneath the Chukchi and Beaufort seas will result in increased human activity on and next to the islands. In 1976 a survey of these islands was conducted in order to determine the importance of these islands to nesting birds. Information on breeding phenology and clutch size was also obtained. Islands that are known to support a larger population or a single species or small populations of a number of species can be considered to be critical habitats. Steps should be taken to minimize the impacts on such islands or to schedule human activities when breeding birds are not present. Islands with smaller populations should also be protected but restrictions on human activity need not be as severe. Because this study identifies which factors are most important in determining the use of islands by breeding birds, it may be possible to increase bird numbers by substrate and cover manipulation on selected islands. Such manipulation would lessen the impact that man's activities will have in reducing the overall number of birds breeding on the islands. (Sinha-OEIS) W79-05676

IDENTIFICATION, DOCUMENTATION AND DELINEATION OF COASTAL MIGRATORY BIRD HABITAT IN ALASKA. II: FEEDING HABITS OF BIRDS IN THE BEAUFORT SEA, Point Reyes Bird Observatory, Stinson Beach, CA.

G. J. Divoky.
In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors—Mammals—Birds, p 549-569, October 1978. 13 tab, 3 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boul-

der, Colorado. 03-5-022-69.

Descriptors: *Migratory birds, *Foods, *Alaska, Ecosystems, Crustaceans, *Outer Continental Shelf, Beaufort Sea, Feeding habits.

In 1976 as part of a general survey of avian use of coastal habitats in the Beaufort Sea a number of birds were collected so that their stomach contents could be analyzed. The objectives of the study were to determine which prey species are most important to the birds feeding in the Beaufort and the relative importance of these species throughout the summer and fall. This report presents the first information on the food of marine birds in the Beaufort Sea. Preliminary results show that a variety of crustaceans are consumed by nearshore birds with amphipods, mysids and euphausiids being the principal prey. For species occurring further offshore Arctic Cod (*Boreogadus saida*) is the most important food. Further analysis of the data will allow the determination of the time periods when each prey species is most important and the habitat in which the prey is usually consumed. The sensitivities of these prey species and habitats can then be examined in order to determine how oil and gas development will affect the populations the birds feed on. (Sinha-OEIS) W79-05677

REPRODUCTIVE ECOLOGY, FOODS AND FORAGING AREAS OF SEABIRDS NESTING ON THE PRIBILOF ISLANDS

California Univ., Irvine.

G. L. Hunt, Jr., B. Mayer, W. Rodstrom, and R. Squibb.

In: Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. 1, Receptors—Mammals—Birds, p 570-775, October 1978. 36 fig, 37 tab, 53 ref, 4 append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-72.

Descriptors: *Birds, *Resources development, *Environmental effects, *Alaska, Aircraft, Baseline studies, Water pollution effects, Oil pollution, *Outer Continental Shelf, Pribilof Islands, Rissa, *Uria Phalarocorax*.

Data were obtained on the breeding season ecology of the eleven seabird species nesting on the Pribilof Islands of Alaska to determine what aspects of this ecology would be particularly sensitive to potential oil development activities. Data suitable for baseline use were obtained in the summers of 1975, 1976, and 1977 for timing of reproduction for Black-legged Kittiwake (*Rissa tridactyla*), Red-legged Kittiwake (*R. brevirostris*), Common Murre (*Uria aalge*) and Thick-billed Murre (*U. lomvia*) and to a modest extent for Red-faced Cormorants (*Phalacrocorax urile*). Preliminary indications of foraging areas for species nesting in the Pribilofs were obtained during cruises in August 1975, June and July 1976, and July and August 1977. On three occasions the effect of aircraft movements close to seabird colonies was noted. The implication is that in OCS oil development and in the coincident monitoring of natural populations, all aircraft should be restricted from flying near colonies. It is likely that, in terms of ongoing oil production, disturbance by aircraft could be as damaging to bird reproduction as spilled oil. These tentative observations have the further implication that aircraft should not be used to monitor the reproductive output of Kittiwakes or the size of bird colonies if these operations require flying in the proximity of cliffs while murre have either eggs or chicks. (Sinha-OEIS) W79-05678

MAN'S IMPACT ON THE MIDDLE ATLANTIC CONTINENTAL SHELF AND THE NEW YORK BIGHT—SYMPOSIUM SUMMARY

Johns Hopkins Univ., Baltimore, MD. Chesapeake Bay Inst.

For primary bibliographic entry see Field 5B. W79-05679

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

PHYSICAL OCEANOGRAPHY OF THE MIDDLE ATLANTIC BIGHT,
Woods Hole Oceanographic Institution, MA.;
Johns Hopkins Univ., Baltimore, MD. Chesapeake
Bay Inst. and National Oceanic and Atmospheric
Administration, Miami, FL. Atlantic Oceanographic
and Meteorological Labs.
For primary bibliographic entry see Field 2J.
W79-05680

NEW YORK BIGHT WATER STRATIFICATION—OCTOBER 1974,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 1A.
W79-05682

DISTRIBUTION OF HYDROGRAPHIC PROPERTIES IN THE NEW YORK BIGHT APEX,
State Univ. of New York at Stony Brook. Marine
Sciences Research Center.
For primary bibliographic entry see Field 1A.
W79-05683

SPATIAL AND TEMPORAL VARIATION IN SEDIMENTARY GRAIN-SIZE FACIES AND SEDIMENT HEAVY METAL RATIOS IN THE NEW YORK BIGHT APEX,
Brooklyn Coll., NY. Dept. of Geology.
W. H. Harris.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 102-123, 1976. 6 fig, 4 tab, 63 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Heavy metals, *Water pollution, *Environmental effects, *Sediments, Spatial distribution, Temporal distribution, Sewage sludge, Chromium, Zinc, Mud, *Outer Continental Shelf, *New York Bight, Ocean dumping.

In northwest New York Bight a pronounced spatial and temporal variation occurs in sediment grain-size, heavy metal ratios, and concentrations. Substrate mobility is most pronounced near Long Island and in northern Christiansen Basin. Near Long Island mud patches are most extensive during late spring through summer and may coalesce across intervening sand-wave crests obliterating the shore-zone sand-wave topography. Mud patches are either restricted to sand-wave trough axes or are absent or covered during early fall through early spring, suggesting that muddy sediments are either flushed from the nearshore wind-wave system by bottom currents or undergo in situ microbial degradation. Individual mud patches near Long Island have not existed for a long time. Mud patches off Atlantic Beach and Lido Beach, Long Island, began to develop as early as summer 1972; others developed later. The Cr:Zn ratio varies in mud deposits at the sludge disposal area, northern Christiansen Basin, and Hempstead Bay and in mud patches near Long Island. Maximum Cr:Zn values occur during late spring through early fall, minimum values during early winter. Cr:Zn annual maximum may be explained by preferential desorption from sludge or mud solids by cation exchange, or preferential adsorption of organic chromium chelates from solution by organic mud substrates, or zinc uptake by phytoplankton or bacteria. The Cr:Zn annual minimum may be explained by dissolution of Mn and Fe hydroxides releasing adsorbed Zn and Cr or oxidation of the organosulfur compounds of the two metals at nearly equal rates. (Sinha-OEIS)
W79-05686

SUSPENDED PARTICULATE CONCENTRATIONS AND COMPOSITIONS IN THE NEW YORK BIGHT,
Lamont-Doherty Geological Observatory, Palisades, NY.
P. E. Biscaye, and C. R. Olsen.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held

in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 124-137, 1976. 14 fig, 1 tab, 8 ref. Allen Press Inc., Lawrence, Kansas. Also as: Lamont-Doherty Geological Observatory Contribution No 2414. ERDA-E(11-1)2185.

Descriptors: *Metals, *Sediment transport, *Environmental effects, Water pollution, Suspended solids, *Outer Continental Shelf, *New York Bight, *Ocean dumping.

Suspended particulate concentrations in the New York Bight during 1973-1975 decrease seaward across the shelf, decreasing more rapidly in surface than in bottom waters. Resuspension of fine-grained sediments causes local high concentrations of suspended particles in near-bottom waters. Horizontal displacement of these high concentration plumes from their sources suggests short residence times for suspended particles. Vertical mixing of resuspended particles is limited by the thermocline. Along the upper continental slope over a depth range of approximately 1,000 m, there is a minimum in near-bottom suspended particulate concentrations suggesting horizontal mixing with waters from the open ocean. Anomalous concentrations of trace metals of anthropogenic origin associated with organic particles, Fe-Ti (oxide) coatings and discrete Ti (oxide) particles are potential tracers of particle dispersion paths and transport processes. Different types of organic particles exhibit different interparticle and trace element associations and appear to have different geographic distributions. Some of this variability may be seasonal. Surface water suspended matter has a higher proportion of biogenic (inorganic skeletal as well as organic) particles than near-bottom suspended matter which is dominantly nonbiogenic (principally aluminosilicate). Skeletal debris is primarily siliceous in shelf waters, becoming more carbonate-rich seaward of the shelf break. Aluminosilicate suspended particles in shelf waters are predominately K-rich whereas Mg-Ca-K-Fe-rich aluminosilicates dominate beyond the shelf break. (Sinha-OEIS)
W79-05687

SOURCES OF URBAN WASTES,
Johns Hopkins Univ., Baltimore, MD. Chesapeake Bay Inst.
For primary bibliographic entry see Field 5B.
W79-05689

CONTAMINANTS ENTERING THE NEW YORK BIGHT: SOURCES, MASS LOADS, SIGNIFICANCE,
Manhattan Coll., Bronx, NY. Dept. of Environmental Engineering and Science.
For primary bibliographic entry see Field 5B.
W79-05690

TRACE METALS IN THE NEW YORK BIGHT,
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.
For primary bibliographic entry see Field 5B.
W79-05691

PRELIMINARY ANALYSIS OF THE DISPERSION OF SEWAGE SLUDGE DISCHARGED FROM VESSELS TO NEW YORK BIGHT WATERS,
Corvallis Environmental Research Lab., OR.
Marine and Freshwater Ecology Branch.
For primary bibliographic entry see Field 5B.
W79-05692

RARITAN BAY AS A SOURCE OF AMMONIUM AND CHLOROPHYLL A FOR THE NEW YORK BIGHT APEX,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5B.
W79-05693

OXYGEN DEPLETION IN THE NEW YORK BIGHT APEX: CAUSES AND CONSEQUENCES,
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.
For primary bibliographic entry see Field 5B.
W79-05694

CARBOHYDRATES AND ORGANIC CARBON IN NEW YORK BIGHT SEDIMENTS AS POSSIBLE INDICATORS OF SEWAGE CONTAMINATION,
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.
For primary bibliographic entry see Field 5B.
W79-05695

A CONCEPTUAL REPRESENTATION OF THE NEW YORK BIGHT ECOSYSTEM,
Resource Management Associates, Lafayette, CA; and Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 5B.
W79-05696

PHYTOPLANKTON PRODUCTIVITY IN THE APEX OF THE NEW YORK BIGHT: ENVIRONMENTAL REGULATION OF PRODUCTIVITY/CHLOROPHYLL A,
City Coll., New York. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W79-05697

MICROBIOLOGICAL STUDIES OF THE ATLANTIC CONTINENTAL SHELF,
Maryland Univ., College Park. Dept. of Microbiology.
R. R. Colwell, J. D. Walker, G. S. Saylor, P. A. Seesman, and B. F. Conrad.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 275-280, 1976. 3 fig, 7 tab, 10 ref. Allen Press, Inc., Lawrence, Kansas. ONR-N00014-67-A-0239-0027.

Descriptors: *Oil pollution, *Polychlorinated biphenyls, Microorganisms, *Sediments, Water pollution effects, Environmental effects, Resources development, Microbial degradation, Drilling, Off-shore platforms, *Outer Continental Shelf, Hydrocarbons, Petroleum, US Southeast Coast.

Microbial degradation of petroleum, polychlorinated biphenyls, and similar substances was investigated in the laboratory and at stations in the Atlantic Ocean near offshore drilling sites. Microorganisms were analyzed as to type, including total viable, aerobic, heterotrophic and petroleum-degrading bacteria, yeasts and fungi, actinomycetes, and chitin-hydrolyzing bacteria. Mixed hydrocarbon substrate generally yielded higher counts than media made up with South Louisiana crude oil. The inorganic nutrient (PO₄, NO₃, NO₂, NH₄) content of the seawater medium influenced the amount of petroleum hydrocarbons degraded by microorganisms present in sediment and in the water column. Sediment bacteria from the deep ocean environment (3,500 m) were able to degrade crude oil; microorganisms present in surface seawater samples collected at stations along the southeast Atlantic coast degraded crude oil, but the microbial potential for degradation of oil was limited. Polychlorinated biphenyl (PCB) and PCB-degrading bacteria were recovered from surface water and sediment samples collected along the southeast Atlantic coast from Miami to Cape Hatteras. Oil and PCB-degrading bacteria are potential indices for oil and PCB contamination. (Sinha-OEIS)
W79-05698

EFFECTS OF COASTAL POLLUTION ON FISH AND FISHERIES—WITH PARTICULAR

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Effects Of Pollution—Group 5C

REFERENCE TO THE MIDDLE ATLANTIC BIGHT,

National Marine Fisheries Service, Highlands, NJ. Middle Atlantic Coastal Fisheries Center. C. J. Sindermann.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 281-301, 1976. 3 fig, 109 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Fish, *Fisheries, *Water pollution effects, *Environmental effects, Heavy metals, Halogenated pesticides, Oil pollution, Sport fishing, *Outer Continental Shelf, New York Bight, Ocean dumping, Petroleum.

Industrial contamination of coastal waters exerts great local impact on fish and shellfish populations. Known offenders include heavy metals, halogenated hydrocarbons, and petroleum residues. Even in low concentrations, many industrial chemicals have profound effects on some or all life stages of marine animals; effects may be reflected in mortality, increased occurrence of abnormalities, and physiological disturbances, with resultant slow growth or spawning inhibition. Orderly development of marine aquaculture in coastal waters can be severely impeded by contaminant-related public health problems, both chemical and microbial, and by contaminant-induced problems associated with survival, reproduction, and growth of cultivated animals. Long term effects on sportfish abundance are difficult to quantify. Available evidence suggests that environmental stress may precipitate diseases in fish and shellfish. Public health aspects are presently confined largely to those microorganisms and toxic substances which do not produce obvious disease in fish and shellfish—but which may be accumulated or transmitted passively to humans from aquatic animal vectors (hepatitis, cholera, typhoid, and mercury poisoning). A few pathogens of fish and shellfish may be transmissible to humans, but a clear role for pollutant effects has not been demonstrated. Evidence exists for localized effects on fisheries, but there is as yet little specific evidence of widespread damage to major fisheries resource populations result from coastal pollution. (Sinha-OEIS) W79-05699

MIDDLE ATLANTIC FISHERIES: RECENT CHANGES IN POPULATIONS AND OUTLOOK,

National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center. R. L. Edwards.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, NY, 3-5 Nov. 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Vol. 2, p 302-311, 1976. 7 fig, 2 tab, 18 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Fisheries, *Population, *Baseline studies, *Surveys, Ecosystems, Water resources, Environmental effects, *Outer Continental Shelf, *New York Bight.

Groundfish survey data from 1963-1965 show that about 22% of the available finfish fishery resources were being harvested. In 1964-1967, standing crops decreased about 40%, indicating that harvesting was at near the maximum rate. All fishery resources were nearly depleted by 1975. Bringing back certain species to traditional levels of abundance would require reducing catches of other species so low as to create more serious problems. The ICNAF 'second tier quota', or biomass approach, evolved from the need to deal effectively with these problems. It is essential that the factors influencing recruitment be determined; these factors may be more density independent than many suppose. The concept of maximum sustainable yield ignores these factors. (Sinha-OEIS) W79-05700

SOME RESULTS OF FISH SURVEYS IN THE MID-ATLANTIC IMPORTANT FOR ASSESSING ENVIRONMENTAL IMPACTS,

National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center. M. D. Grosslein.

In: 'Middle Atlantic Continental Shelf and the NY Bight', Proceedings of symposium, held in NY, NY on 3-5 Nov. 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Vol. 2, p 312-328, 11 fig, 1 tab, 10 ref.

Descriptors: *Water pollution effects, *Fish, *Surveys, *Environmental effects, Baseline studies, Resources development, Waste disposal, Ecosystems, *Outer Continental Shelf, *New York Bight.

Knowledge of the distribution, biomass, and composition of the major biological communities is essential to the data base required for assessing the impact of environmental change on the marine ecosystem. Since 1967 the National Marine Fisheries Service has conducted regular trawl surveys in the mid-Atlantic, providing quantitative measures of density distributions of demersal fish populations. The surveys show that each species occupies wide areas of the shelf and that there is a high degree of species mixture, particularly in the New York Bight. Significant numbers of adult stages, planktonic eggs, and larvae can be found over the whole mid-Atlantic shelf all year. Thus there are no shelf areas free of risk from potential damage from waste disposal activities. Impacts of any change must consider a multispecies community and include all life stages. Precision of large-scale surveys is relatively low, making it difficult to detect any but major changes. Broad-scale surveys must be augmented with detailed laboratory and field experiments on physiology and behavior (especially food chains) of selected organisms and communities to get insight into probable effects of sublethal factors. The complexity and scope of marine ecosystems require long term but well coordinated research programs to ensure proper integrations of small- vs. large-scale studies and field vs. laboratory experiments. (Sinha-OEIS) W79-05701

FIN ROT DISEASE STUDIES IN THE NEW YORK BIGHT,

National Marine Fisheries Service, Oxford, MD. Middle Atlantic Coastal Fisheries Center. R. A. Murchelano, and J. Ziskowski.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 329-335, 1976. 3 fig, 3 tab, 8 ref. Allen Press, Inc., Lawrence, Kansas.

Descriptors: *Fish diseases, *Water pollution effects, *Environmental effects, Bottom sediments, Sediments, Sewage sludge, *Outer Continental Shelf, *New York Bight, *Fin rot disease, Flatfish, Flounder, Pseudopleuronectes americanus, Paralichthys dentatus.

Surveys from February 1974 through June 1975 showed the prevalence of fin rot disease in winter flounder (*Pseudopleuronectes americanus*) from the New York Bight apex was 3.9%, compared to 0.7% outside the apex. Prevalence of the disease in winter flounder from apex areas of low carbon deposits was 2.9%; whereas, in apex areas of high carbon deposits, disease prevalence was 5.1%. The prevalence of fin rot disease in summer flounder (*Paralichthys dentatus*) from the apex was 0.5% and in summer flounder from Sandy Hook-Raritan Bay was 3.4%. No summer flounder with fin rot were noted in Great Bay, a control area outside the apex. Although the numbers of diseased fish are small, incidence of fin rot disease in summer flounder from Sandy Hook-Raritan Bay increased monthly from June-November 1974. Attempts to induce fin rot disease in winter flounder in cages submerged in the sewage sludge area of the bight apex produced active fin lesions on the caudal fins more often than on the dorsal and anal fins. These

flounder were in substantially worse condition than fish in cages at the control site. (Sinha-OEIS) W79-05702

CHROMOSOME MUTAGENESIS IN DEVELOPING MACKEREL EGGS SAMPLED FROM THE NEW YORK BIGHT,

National Marine Fisheries Service, Milford, CT. Experimental Biological Investigations. A. C. Longwell.

In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 337-339, 1976. 1 fig, 8 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Fish eggs, *Heavy metals, *Water pollution effects, Pesticides, Cadmium, Environmental effects, *Outer Continental Shelf, *New York Bight, *Mutagenesis, *Chromosome mutagenesis, Mackerel eggs.

Certain heavy metals and pesticides are recognized mutagens and, along with some other major classes of marine contaminants, may have important implications in survival of fish populations. This may be particularly so for fish using the polluted New York Bight as spawning grounds. Mutagens can cause genetic damage at subtoxic levels. Many marine contaminants accumulate in the body tissues of fish and other marine species. Cadmium has been shown to be absorbed from seawater by post-spawned fish eggs. The chromosomes of developing fish eggs provide a sensitive test for genetically active substances, both experimentally and in polluted natural waters. Any new determination of mortality of early fish stages, irrespective of its cause, would have important bearing on the general theories of fluctuations of fish populations and on predictions of success of any year class of commercial fish. Two stations just south of Long Island were among those with the lowest incidences of chromosome aberrations and mitotic irregularities. A third station farther up the Long Island coast had a slightly higher incidence. The station with the highest mean off the New Jersey coast was the only one with any significant observable mortality. On the basis of cell contrast and deterioration of the nuclei, 20 of 76 embryos (26%) were already dead. There was not yet any gross deterioration of the embryo or egg. Also, there were more instances of multiple chromosome abnormalities within mitosing cells of embryos from this station. (Sinha-OEIS) W79-05703

BACTERIAL FLUX IN SOME NEW JERSEY ESTUARINE SEDIMENTS,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Microbiology; and Rutgers - The State Univ., New Brunswick, NJ. Marine Sciences Center.

For primary bibliographic entry see Field 2L. W79-05704

SEABED OXYGEN CONSUMPTION—NEW YORK BIGHT APEX,

National Marine Fisheries Service, Highlands, NJ. Middle Atlantic Coastal Fisheries Center.

J. P. Thomas, W. C. Phoel, F. W. Steimle, J. E. O'Reilly, and C. A. Evans.

In: 'Middle Atlantic Continental Shelf and New York Bight', Proceedings of symposium, NY on 3-5 Nov. 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Vol. 2, p 354-369, 1976. 7 fig, 4 tab, 40 ref.

Descriptors: *Waste disposal, *Water pollution effects, *Oxygen, Benthos, Environmental effects, Sediment, Sewage sludge, Industrial wastes, *Outer Continental Shelf, *New York Bight, *Ocean dumping, *Oxygen uptake, Dredge spoil.

Seabed oxygen consumption rates, temperature, salinity, and dissolved oxygen were measured during five cruises in the New York Bight apex

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

between March 1974 and August 1975. The area sampled included the waste disposal sites for sewage sludge, dredge spoils, and industrial acid wastes. Samples were collected and incubated on shipboard at in situ temperature during oxygen uptake measurements. In winter the highest rates of uptake were measured in the Christiaensen Basin adjacent to the sewage sludge disposal site, in the topographically high dredge spoil disposal area west of the Christiaensen Basin, and in the Hudson Shelf Valley. In summer the highest rates were measured in the dredge spoil area. Rates in the Christiaensen Basin, however, were low compared with the surrounding areas and were more like winter rates. This difference may have been caused by differential sedimentation rates of oxidizable organic carbon to the seabed, mediated by the presence or absence of a thermocline. The highest rates were measured near a municipal sewage outfall off Asbury Park, N.J. No discernible effects on seabed oxygen consumption were observed near the acid waste disposal area. Rates of oxygen uptake by the bottom water and by the entire water column were measured and compared with oxygen uptake rates by the sediment. Most (93%-98%) oxygen uptake in the apex occurs in the water column and not on the seabed. (Sinha-OEIS) W79-05705

BENTHIC-PELAGIC COUPLING IN THE NEW YORK BIGHT,
Woods Hole Oceanographic Institution, MA.
G. T. Rowe, K. L. Smith, Jr., and C. H. Clifford.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 370-376. 3 fig. 1 tab, 25 ref. Allen Press, Inc., Lawrence, Kansas.

Descriptors: *Bottom sediments, *Waste disposal, Sewage sludge, *Water pollution effects, Baseline studies, Ecosystems, Nutrients, Oxygen, *Outer Continental Shelf, *New York Bight, Ocean dumping.

Bottom sediment oxygen consumption can be used to estimate how much of the energy incorporated by the phytoplankton is utilized by the benthos, and such rates are directly related to temperature, organic matter in the sediment, availability of dissolved oxygen, and primary production in the water column. Nutrient flux out of sediments has been measured directly by incubating areas of bottom under bell jarlike chambers. Fluxes of major inorganic plant nutrients are often high, indicating that in most nearshore environments most regeneration occurs on the bottom. In the New York Bight, oxygen consumption by the bottom was measured in four different seasons; we concluded it was high enough to oxidize a large fraction of the daily input of sludge. Bottom water ammonia gradients suggested too that remineralization rates were high on the bottom in the bight. Samples taken in August 1975, in Christiaensen Basin, along with measurements in situ of ammonia flux from the bottom, confirmed that the sediments enriched by sewage sludge are regenerating nutrients but at that time not at rates as high as our earlier predicted rates for the mid-Atlantic Bight. (Sinha-OEIS) W79-05706

BENTHIC COLONIZATION PROCESSES—A REVIEW AND A PROPOSED NEW MODEL,
Rhode Island Univ., Kingston. Dept. of Mathematics; and Rhode Island Univ., Kingston. Graduate School of Oceanography.
J. S. Papadakis, and S. B. Saila.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 377-382, 1976. 5 fig. 1 tab, 16 ref. Allen Press Inc., Lawrence, Kansas. URI 98-19-3135L, 98-00-8025.

Descriptors: *Benthos, *Models, *Water pollution effects, Environmental effects, Baseline studies, *Outer Continental Shelf, *New York Bight, Ocean dumping, Colonization.

The new model proposed here is based on the assumption of a constant environment or a priori knowledge of its dependence on time and recruitment into the area by motile juvenile forms. The model can accommodate any number of species for which data are available. The above assumptions are formulated into a linear immigration death process. To model species interactions, the immigration rate of each species is assumed to be a function of the total biomass in the area at time t and the carrying capacity. The distribution of the number of individuals in a species is assumed to be approximated by a Poisson distribution. The model was implemented on a digital computer. The required input parameters are the initial number, immigration rate, death rate, and average biomass of organisms by species. An estimate of the environmental carrying capacity is also required. The relatively great data requirements have limited further empirical testing, nevertheless, it is the best available tool for better understanding and predicting recovery from catastrophic events. (Sinha-OEIS) W79-05707

ANTIMICROBIAL RESISTANT BACTERIA IN THE NEW YORK BIGHT,
Montclair State Coll., Upper Montclair, NJ. Dept. of Biology.
L. Koditschek.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 383-393, 1976. 1 fig. 7 tab, 41 ref. Allen Press, Inc. Lawrence, Kansas. NOAA-N-043-48-72.

Descriptors: *Bacteria, *Mercury, *Antibiotics (Pesticides), *Sediments, Coliforms, Water pollution effects, Environmental effects, *Outer Continental Shelf, *New York Bight, Ocean dumping.

Sediment samples and overlying water from stations around the sewage dump site in the New York Bight were analyzed for coliform and noncoliform bacteria resistant to mercury and antibiotics. Few or no coliforms could be found in these samples, but a pollution gradient was identified in a northeasterly direction, toward Long Island. About 1% of the sediment bacteria desorbed was consistently resistant to HgC1210-3M and/or tetracycline 40 mcg/ml at MESA station 34. The antibiogram of a majority of the isolates from these sediments showed multiple antibiotic resistance. Sediments from which antimicrobial resistant bacteria were isolated had high bound water content, much debris, little or no evidence of normal benthic macrofauna and a black, gelatinous consistency. In contrast, sediment taken from the Sandy Hook transect showed no resistant bacteria, and demonstrated no other parameters related to pollution. Analysis of water and sediments containing very small numbers of coliforms from a beach at Sandy Hook State Park revealed a significant number of bacteria resistant to seven or more antibiotics. These data suggest that techniques used in these studies may detect pollution gradients which are not measurable by coliform counts. (Sinha-OEIS) W79-05708

TEMPORAL AND SPATIAL DISTRIBUTIONS OF BENTHIC MACROINVERTEBRATES IN THE NEW YORK BIGHT,
National Marine Fisheries Service, Highlands, NJ. Middle Atlantic Coastal Fisheries Center.
J. B. Pearce, J. V. Caracciolo, M. B. Halsey, and L. H. Rogers.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 394-403, 1976. 4 fig. 1 tab, 38 ref. Allen Press, Inc., Lawrence, Kansas.

Descriptors: *Temporal distribution, *Spatial distribution, *Benthos, Water pollution effects, Environmental effects, Baseline studies, *Outer Continental Shelf, *New York Bight, Ocean dumping, Organic carbon.

Benthic biota in the New York Bight apex is characterized by high spatial and temporal variability. A considerable reduction in numbers of individuals per sample was observed between August 1973 and August 1974; on an average, numbers of individuals per sample was observed between August 1973 and August 1974; on an average, numbers of individuals per station decreased from 417 to 174. Low species diversity was observed at some stations inside the Christiaensen Basin, an area characterized by high organic carbon values in sediment. Certain species, apparently tolerant of carbon-rich deposits of the Christiaensen Basin, were extremely abundant at some stations located in the basin. These included the anemone *Cerianthus*, four species of polychaete, and the bivalve *Nucula*. (Sinha-OEIS) W79-05709

DISTRIBUTION AND ABUNDANCE OF IN-SHORE POPULATIONS OF THE SURF CLAM SPISULA SOLIDISSIMA,
Brooklyn Coll., New York. Dept. of Biology.
D. R. Franz.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, NY on 3-5 Nov. 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc., Special Symposia, Vol. 2, p 404-413, 1976. 8 fig. 1 tab, 12 ref. NOAA/NMFS 03-4-043-355.

Descriptors: *Clams, *Water pollution effects, Environmental effects, Baseline studies, Waste disposal, Distribution, *Outer Continental Shelf, New York Bight, Ocean dumping, *Spisula solidissima*.

The distribution and abundance of juvenile and adult surf clams were determined inshore of the 3-mi contour in July 1974 at 141 sites off Long Island, New York. Transects were located every 2 mi from Montauk to Rockaway Point, and samples were taken at 0.5, 1.5, and 2.5 mi offshore. Selected stations were revisited in July 1975. East of Shinnecock Inlet adult clams occurred at densities between 0.5 and 3.0 bushels per dredge haul. West of Shinnecock adults declined gradually, reaching a minimum west of Jones Inlet to East Rockaway Inlet. Abundances increased precipitously off Rockaway Beach. Highest densities of juveniles occurred at 0.5 mi and decreased rapidly farther offshore. Juveniles were more abundant at the west end of Long Island, particularly inshore at 0.5 mi. Higher densities of juveniles here may result from accumulation of larvae produced farther east and transported westward via longshore currents. The convergence of tidal and longshore currents may effectively 'trap' larvae off western Long Island. Clam stocks off eastern Long Island probably are older than 9 years and are mostly composed of 1-3 age classes. Clam stocks off the Rockaways appear younger. The commercial fishery is apparently dependent on massive settlements of larvae occurring irregularly and infrequently. (Sinha-OEIS) W79-05710

INFECTIOUS DISEASES IN COMMERCIAL SHELLFISH ON THE MIDDLE ATLANTIC COAST,
National Marine Fisheries Service, Oxford, MD. Middle Atlantic Coastal Fisheries Center.
A. Rosenfield.
In: 'Middle Atlantic Continental Shelf and the New York Bight', Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Vol. 2, p 414-423, 1976. 71 ref. Allen Press, Inc., Lawrence, Kansas.

Descriptors: *Waste disposal, *Chlorinated hydrocarbons, *Virus, *Shrimp, *Bight, *Ocean

Proliferation have been recently and portions h Gonadal (aria) have spills. Stu Hook Bay parasitic rock crabs Homarus crabs near New York Naturally blue crabs in crustacea blue crabs cently been activate p exposed t Viruses n the prese W79-05711

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Effects Of Pollution—Group 5C

Descriptors: *Water pollution effects, *Shellfish, *Waste disposal, *Oil spills, *Fish diseases, Polychlorinated biphenyls, Crustaceans, Mollusks, Environmental effects, Clams, Crabs, Lobsters, Shrimp, *Outer Continental Shelf, *New York Bight, *Ocean dumping, *Mya arenaria*.

Proliferative cell conditions in marine shellfish have been reported with increased frequency recently and neoplasms of molluscs in epizootic proportions have been reported from both U.S. coasts. Gonadal neoplasms in soft-shell clams (*Mya arenaria*) have been found in areas associated with oil spills. Studies of benthic crustaceans from Sandy Hook Bay and the New York Bight show that the parasitic amoeba *Paramoeba pernix* occurs in rock crabs *Cancer irroratus* and American lobsters *Homarus americanus*. Lobsters, shrimp, and rock crabs near sludge and spoil disposal grounds in the New York Bight had shell erosion and ulcers. Naturally occurring bacteremias in lobsters and blue crabs have been reported and may play a role in crustacean epizootics. Virus-like infections in blue crabs from Chincoteague Bay have been recently noted. Polychlorinated biphenyls may activate production of a Baculovirus in shrimp exposed to sublethal levels of these compounds. Viruses may be latent in shellfish and activated by the presence of certain chemicals. (Sinha-OEIS) W79-05711

THE IMPACT OF POLLUTION ON MARINE BATHING BEACHES: AN EPIDEMIOLOGICAL STUDY.

Environmental Research Lab., Narragansett, RI. V. J. Cabelli, A. P. Dufour, M. A. Levin, and P. W. Habermann.
In: Middle Atlantic Continental Shelf and the New York Bight, Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 424-432, 1976. 4 fig. 3 tab, 20 ref. Allen Press Inc., Lawrence, Ka.

Descriptors: *Water pollution effects, *Water quality, *Beaches, Public health, Swimming, Coliforms, *Outer Continental Shelf, *New York Bight, Ocean dumping, *Escherichia coli*.

As part of a national program to develop health effects criteria for marine recreational waters, the U.S. Environmental Protection Agency conducted a prospective epidemiological-microbiological study at bathing beaches in the vicinity of New York City, specifically at 20th St. on Coney Island and 67th St. and Ribs Park at the Rockaways. The most consistent findings over the first 2 years of this study were that, for most of the water quality indicators examined, the mean densities at the Coney Island beach were appreciably and significantly higher than those at the Rockaways, and that the rate of gastrointestinal (GI) symptoms was significantly higher among swimmers relative to nonswimmers at the Coney Island beach but not at the Rockaways. When the data from two summers at both beaches (four points) were examined, good agreement was obtained between the mean *Escherichia coli* and enterococcus densities and the differential (swimmers minus nonswimmers) rate of GI symptoms. This preliminary finding addresses the objective of the study: relating illness as measured by symptomatology to some indicator of water quality. (Sinha-OEIS) W79-05712

SAFE SHELLFISH FROM THE SEA.

Food and Drug Administration, Davisville, RI. Shellfish Sanitation Branch.

J. L. Verber.

In: Middle Atlantic Continental Shelf and the New York Bight, Proceedings of symposium, held in New York, NY on 3-5 November 1975. M. Grant Gross (Ed.) American Society of Limnology and Oceanography, Inc. Special Symposia, Volume 2, p 433-441, 1976. 4 fig. 2 tab, 20 ref. Allen Press Inc., Lawrence, Kansas.

Descriptors: *Shellfish, *Public health, *Waste disposal, *Water pollution effects, Sewage sludge,

Bacteria, Fish diseases, Environmental effects, *Outer Continental Shelf, *New York Bight, Ocean dumping, Dredge spoil, Typhoid.

The National Shellfish Sanitation Program was initiated in 1925 after a widespread typhoid fever outbreak caused by raw oysters. Specific recommendations made in 1925 established guidelines for classifying offshore waters for clam harvesting and stated that shellfish being harvested must not be exposed to fecal contamination. In 1974, sea clams accounted for 59% of all shellfish (oysters, clams, and mussels) harvested from United States waters. The Food and Drug Administration is responsible for classifying the offshore water beyond 5.5 km for harvesting shellfish. In recent years, the sea has been used increasingly for sewage sludge and industrial waste disposal. Depletion of the resources in the original major sea clam harvest area off New Jersey and increased demand (43 million kg were harvested in 1974) have caused the industry to expand its area of operation to the southeast in search of more productive shellfish beds. There too, heavy population and industrial growth have increased the amounts of chemical wastes, sewage sludge, and other waste materials being disposed of at sea. Warning notices to harvesters, closing areas of the New York Bight to shellfishing, have been posted since 1970. High bacterial levels are found in both the sewage sludge and dredge spoil sites. (Sinha-OEIS) W79-05713

BIOMASS AND SPECIES RICHNESS OF THE MACROBENTHIC ANIMALS LIVING ON THE TIDAL FLATS OF THE DUTCH WADDEN SEA: LONG-TERM CHANGES DURING A PERIOD WITH MILD WINTERS, Netherlands Inst. voor Onderzoek der Zee, Texel. J. J. Beukema, W. De Bruin, and J. J. M. Jansen. Netherlands Journal of Sea Research, Vol. 12, No. 1, p 58-77, 1978.

Descriptors: *Biomass, *Wadden Sea(Netherlands), *Species richness, *Benthic fauna, *Tidal flats, *Cold resistance, Seas, Netherlands, Clams, Mussels, Worms, Mollusks, Bivalves, Faunal lists, Winter, Recruitment, Temperature, *Mya arenaria*, *Arenicola marina*, *Macoma balthica*, *Mytilus edulis*, *Angulus tenuis*, *Janice conchilega*, *Nephtys hombergii*.

Total biomass estimates were similar but species composition different in 1971-72 and 1977 studies of macrobenthic fauna on the tidal flats of the western half of the Wadden Sea, the Netherlands. *Mya arenaria* (gaper clam), *Arenicola marina* (lugworm), and *Macoma balthica* (tellinid clam) declined significantly, while biomass of *Mytilus edulis* (mussel), *Janice conchilega* (tube-building worm), *Nephtys hombergii* (worm), and *Angulus tenuis* (tellinid bivalve) increased. Species density increased, both as higher total number of species and by increased frequency of occurrence of *Angulus tenuis* and *L. conchilega*. Declines were attributed primarily to failing recruitment, and increases to better survival during mild winters over the study period. Of 49 transects sampled in 1971-72, 48 were again sampled in 1977. Along each one-km transect 25 cores of 0.018 sq m and 30-40 cm deep were taken and sieved through a one-mm sieve. Animals were counted and ash-free dry weight estimated for each species in each transect. Species richness (number of species in pooled samples along a transect) was 10% higher in 1977 than in 1971-72. Forty-two species were identified in the second survey, compared with 34 during the first (only three of which were not found in 1977), but the 11 new species accounted for less than half of the increase in species density. (Lynch-Wisconsin) W79-05718

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART I. SUMMARY.

Battelle Pacific Northwest Lab., Richland, WA. A. Brandstetter, R. G. Baca, A. F. Gasperino, and A. S. Myhr.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 912,

Price codes: A03 in paper copy, A01 in microfiche. Report January 1977. 22 p, 13 fig, 1 tab, 7 ref.

Descriptors: *Computer models, *Adelaide(Australia), *Reservoirs, *Water supply, *Eutrophication, *Water pollution effects, *Lake restoration, *Mt. Bold Reservoir(Australia), Model studies, Australia, Limnology, Lakes, Municipal water, Algae, Biochemical oxygen demand, Dissolved oxygen, Ecology, Cycling nutrients, Phosphorus, Nutrients, Land use, Water management(Applied), Lake Washington(WA), Washington, Computer programs, Mathematical models, Trophic levels, Chlorophyll, Secchi disks.

This volume summarizes a project to develop eutrophication model and a limnological model to predict and simulate eutrophication and other water quality changes in the municipal water supply reservoirs of Adelaide, Australia, and to evaluate the effectiveness of lake restoration schemes. Three other volumes cover: (1) model formulation, calibration, and verification; (2) user's manual; and (3) Mt. Bold Reservoir data acquisition and evaluation. The detailed limnological model predicts daily changes of all important water quality phenomena, including thermal stratification, dissolved oxygen, nutrient cycling, and algal growth and decay, over several seasons (less than 10 years). The eutrophication model, which requires minimal data, can predict monthly changes in key trophic indicators over many years (10 or more). Two models together provide the information necessary for assessing detailed short-term water quality fluctuations and general long-term eutrophication trends resulting from alternative land use and lake management plans. The eutrophication model was tested with data from Lake Washington (Washington) for 1933-72, with good agreement. The limnological model was tested with data from Mt. Bold Reservoir near Adelaide for 1973-75, with good results for all parameters except suspended sediment, for which there was not sufficient data. The models were programmed in Fortran IV. (See W79-05729 thru W79-05731) (Lynch-Wisconsin) W79-05728

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART 2. MODEL FORMULATION, CALIBRATION AND VERIFICATION.

Battelle Pacific Northwest Lab., Richland, WA. R. G. Baca, A. F. Gasperino, A. Brandstetter, and A. S. Myhr.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 913, Price codes: A07 in paper copy, A01 in microfiche. Report January 1977. 122 p, 28 fig, 11 tab, 33 ref, 1 append.

Descriptors: *Computer models, *Reservoirs, *Adelaide(Australia), *Eutrophication, *Limnology, *Water supply, *Water pollution effects, *Lake restoration, *Mt. Bold Reservoir(Australia), Model studies, Mathematical models, Lakes, Australia, Municipal waters, Algae, Biochemical oxygen demand, Dissolved oxygen, Lake Washington(WA), Sediment-water interfaces, Cycling nutrients, Phosphorus, Nitrogen, Washington, Trophic level, Forecasting, Phytoplankton, Zooplankton, Chlorophyll, Secchi disks, Water management(Applied).

Formulations, calibration, and verification of a eutrophication model and a limnological model for predicting and simulating water quality changes in municipal water supply reservoirs of Adelaide, Australia, are described. These computer models apply to both shallow and deep lakes and reservoirs. The eutrophication model incorporates inflows and outflows, fluctuations of the thermocline, nutrient fixation and mineralization, and sediment-water interactions to simulate monthly changes of four eutrophication indicators: (1) soluble phosphorus, (2) total phosphorus, (3) chlorophyll-a, and (4) Secchi disk depth. The limnological model is based on dynamics of heat and mass transport, hydromechanics, and chemical and biological transformations. The model simulates daily vertical and horizontal variations of: (1) water flow

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and temperature, (2) phytoplankton and zooplankton biomass, (3) nitrogen and phosphorus forms, (4) BOD, (5) DO, (6) total dissolved solids, and (7) suspended sediments. The eutrophication model was verified with data from Lake Washington (Washington) for 1933-72, which showed its ability to predict changes in lake trophic state, and the limnological model was tested with data from Mt. Bold Reservoir near Adelaide for 1973-75 with good results, except for suspended sediment for which data were insufficient. Three other volumes provide a summary of the project, a user's manual, and Mt. Bold Reservoir data acquisition and evaluation. (See also W79-05728) (Lynch-Wisconsin) W79-05729

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS. PART 3. USER'S MANUAL.

Battelle Pacific Northwest Labs., Richland, WA. R. G. Baca, A. S. Myhr, A. Brandstetter, and A. F. Gasperino. Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 914. Price codes: A05 in paper copy, A01 in microfiche. Report January 1977. 83 p, 6 fig, 24 tab, 43 ref.

Descriptors: *Computer models, *Manuals, *Reservoirs, *Eutrophication, *Limnology, *Water pollution effects, *Lake restoration, *Mt. Bold Reservoir(Australia), Adelaide(Australia), Australia, Model studies, Mathematical models, Computer programs, Lakes, Biochemical oxygen demand, Dissolved oxygen, Cycling nutrients, Phosphorus, Nitrogen, Phytoplankton, Zooplankton, Algae, Trophic level, Forecasting, Chlorophyll, Secchi disks, Water quality, Biomass, Dissolved solids, Suspended sediments, Water management(Applied).

A manual gives detailed user's instructions for two mathematical models developed to predict and simulate eutrophication and other water quality changes in municipal water supply reservoirs of Adelaide, Australia. The eutrophication model and limnological model apply to both deep and shallow lakes and reservoirs. This manual provides detailed input instruction, an explanation of required input data, and samples of model input and output. The eutrophication models predicts monthly average changes in lake trophic state in terms of soluble and total phosphorus, chlorophyll-a, and Secchi disc depth over many years (10 or more). The computer program of this model is written as one main program. The limnological model predicts daily horizontal and vertical flow and water quality patterns over short-term periods (less than 10 years), simulating water flow and temperature, phytoplankton and zooplankton biomass, nitrogen and phosphorus forms, BOD, DO, total dissolved solids, and suspended sediments. The computer program of this model consists of four main sub programs coupled by common input and output, and run in sequence. The models were verified with data from Lake Washington (Washington) and from Mt. Bold Reservoir near Adelaide. Three other volumes provide a summary of the project; model formulation, calibration, and verification; and Mt. Bold Reservoir data acquisition and evaluation. (See also W79-05728) (Lynch-Wisconsin) W79-05730

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS. PART 4. MT. BOLD RESERVOIR DATA ACQUISITION AND EVALUATION.

Battelle Pacific Northwest Labs., Richland, WA. A. F. Gasperino, A. Brandstetter, A. S. Myhr, and R. G. Baca. Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 915. Price codes: A05 in paper copy, A01 in microfiche. Report January 1977. 82 p, 81 fig, 7 tab, 8 ref.

Descriptors: *Mt. Bold Reservoir(Australia), *Water supply, *Computer models, *Municipal water, *Adelaide(Australia), *Limnology, Data collections, Calibration, Verification, Reservoirs, Australia, Model studies, Mathematical models, Eutrophication, Meteorological data, Lake mor-

phometry, Water quality, Data processing, Algae, Biochemical oxygen demand, Dissolved oxygen, Water pollution effects, Ecology, Lake restoration, Onkaparinga River(Australia), Echunga Creek(Australia), Rivers, Streams, Water management(Applied).

Data from Mt. Bold Reservoir, part of the municipal water supply system of Adelaide, Australia, used in calibrating and verifying a computerized limnological model are documented and evaluated. The limnological model and an accompanying eutrophication model were developed for predicting and simulating water quality changes in Adelaide's water supply reservoirs. Data pertain to water flow, water quality, meteorology, and morphometry of the reservoir. Data were plotted with existing computer programs to examine consistency and accuracy, and to study spatial and temporal trends. Evaluation results indicated a need for additional field measurements, and a data acquisition program is recommended to provide data needed for future model applications. Verification of the limnological model with data from 1973-75 indicated good results except for suspended sediment, for which data were insufficient. Effects of salinity and color on algal growth could not be simulated due to lack of inflow and lake data, and data were likewise inadequate to calibrate the eutrophication model, which was therefore tested with data from Lake Washington (Washington). Three other volumes provide a summary of the entire project; model formulation, calibration, and verification; and a user's manual. (See also W79-05728) (Lynch-Wisconsin) W79-05731

A COMPENDIUM OF LAKE AND RESERVOIR DATA COLLECTED BY THE NATIONAL EUTROPHICATION SURVEY IN THE CENTRAL UNITED STATES.

Working Paper No 476, September 1978; U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Oregon. 199 p.

Descriptors: *National Eutrophication Survey, *Eutrophication, *Lakes, *Reservoirs, *Data collections, *Central US, Great Plains, Nutrient loading, Lake morphometry, Limnology, Trophic level, Phytoplankton, Algae, Limiting factors, Nutrients, Point pollution, Nonpoint pollution, Nitrogen, Phosphorus, Water chemistry, Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Texas.

Morphometric, limnological, and nutrient loading data collected in 1974 during EPA's National Eutrophication Survey are summarized for 182 lakes and reservoirs in the central and plains states. States included: Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas. A brief introduction describes data collection methodology. Data are arranged in five categories for each body of water: (1) morphometry, (2) physical and chemical characteristics, (3) biological characteristics, (4) nutrient loading, and (5) nonpoint source nutrient export. A trophic level designation is also given (oligotrophic, mesotrophic, eutrophic, or hypereutrophic). Morphometric data include drainage and surface area, mean depth, total inflow, and retention time. Physical/chemical characteristics include median alkalinity, conductivity, total phosphorus, orthophosphorus, inorganic nitrogen, and mean Secchi disc depth. Biological characteristics include mean chlorophyll-a, algal assay control yield, limiting nutrient, and a count of phytoplankton by genera. Nutrient loading data include phosphorus and nitrogen input (municipal), industrial, and septic tank point sources, nonpoint sources, and total loading) and output (outlet, percent retention, and lake surface area loading rate). Nonpoint source nutrient export includes (by specific stream): mean flow, drainage area, mean total phosphorus and nitrogen, and total phosphorus and nitrogen export. (Lynch-Wisconsin) W79-05732

A COMPENDIUM OF LAKE AND RESERVOIR DATA COMPILED BY THE NATIONAL EUTROPHICATION SURVEY IN THE WESTERN UNITED STATES.

Working Paper No 477, September 1978; U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Oregon. 168 p.

Descriptors: *National Eutrophication Survey, *Eutrophication, *Lakes, *Reservoirs, *Data collections, *Southwest US, *Rocky Mountain Region, Pacific Coast Region, Nutrient loading, Lake morphometry, Limnology, Trophic level, Phytoplankton, Algae, Limiting factors, Nutrients, Point pollution, Nonpoint pollution, Nitrogen, Phosphorus, Water chemistry, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

Morphometric, limnological, and nutrient loading data collected in 1975 during EPA's National Eutrophication Survey are summarized for 136 lakes and reservoirs in the Rocky Mountain and far-western states. States included: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. A brief introduction describes data collection methodology. Data are arranged in five categories for each body of water: (1) morphometry, (2) physical and chemical characteristics, (3) biological characteristics, (4) nutrient loading, and (5) nonpoint source nutrient export. A trophic level designation is also given (oligotrophic, mesotrophic, eutrophic, or hypereutrophic). Morphometric data include drainage and surface area, mean depth, total inflow, and retention time. Physical/chemical characteristics include median alkalinity, conductivity, total phosphorus, orthophosphorus, inorganic nitrogen, and total nitrogen, and mean Secchi disc depth. Biological characteristics include mean chlorophyll-a, algal assay control yield, limiting nutrient, and a count of phytoplankton by genera. Nutrient loading data include phosphorus and nitrogen input (municipal), industrial, and septic tank point sources, nonpoint sources, and total loading) and output (outlet, percent retention, and lake surface area loading rate). Nonpoint source nutrient export includes (by specific stream): mean flow, drainage area, mean total phosphorus and nitrogen, and total phosphorus and nitrogen export. (Lynch-Wisconsin) W79-05733

A PHOSPHORUS BUDGET FOR LAKE BURLEY GRIFFIN AND MANAGEMENT IMPLICATIONS FOR URBAN LAKES.

P. Cullen, R. Rosich, and P. Bek. Australian Water Resources Council. Technical Paper No 31, 1978. Research project No 75/92. 220 p, 35 fig, 88 tab, 252 ref, 3 append.

Descriptors: *Urban lakes, *Lake Burley Griffin(Australia), *Phosphorus, *Nutrient budgets, *Eutrophication, *Water pollution control, *Aquatic weed control, *Water pollution sources, *Water quality control, Lakes, Australia, Canberra(Australia), Nutrients, Zinc, Sewage disposal, Primary productivity, Limiting factors, Algae, Phytoplankton, Macrophytes, Light penetration, Turbidity, Wetlands, Molonglo River(Australia), Queanbeyan River(Australia), Urban runoff, Agricultural runoff, Sedimentation, Flooding, Artificial lakes, Urban hydrology, Water management, Mechanical control.

A phosphorus budget was constructed for Lake Burley Griffin in Canberra, Australia, contaminated by runoff and treated sewage from the upstream city of Queanbeyan, and by agricultural drainage. The lake can be classified eutrophic based on nutrient content and algal and macrophyte species, but primary productivity is limited by turbidity-restricted light penetration by turbidity (a view supported by Vollenweider's phosphorus-loading model), and possibly by zinc pollution, which modifies the eutrophic classification. Completion of the Googong Dam and Captains Flat pollution control works may eliminate these productivity limitations through restriction of sediment movement and reduction of zinc pollution. Phosphorus forms were measured weekly 1975-77 at 13 stations

and upstream and downstream in the lake. Conclusions: (1) floods contributed 69% of total phosphorus, and 90% of flood phosphorus came from nonurban agricultural and forest lands; (2) Queanbeyan sewage effluent contributed 72% of phosphorus during normal periods and 90% during droughts; (3) urban runoff contributed only 3.5% of total phosphorus (3% of the watershed is urbanized); and (4) phosphorus export ranged from 0.91 kg P/ha/yr in the Canberra urban area to 0.26 kg in the Queanbeyan River watershed. Recommendations: (1) replace most herbicide spraying of macrophytes with harvesting, (2) conserve adjacent wetlands for nutrient control, (3) divert dry-weather Molonglo River flow through basins supporting macrophytes, (4) utilize Queanbeyan sewage effluent for agricultural irrigation, and (5) use caution in applying phosphorus fertilizers to surrounding parks. (Lynch-Wisconsin) W79-05734

THE CULTURE OF THE DIATOM CHAETOCEROS GRACILIS AND ITS USE AS A FOOD FOR PENAEID PROTOZOAL LARVAE.
Oceanic Inst., Waimanalo, HI.
C. M. Simon.
Aquatulture, Vol 14, No 2, p 105-113, June 1978. 3 fig, 2 tab, 12 ref.

Descriptors: *Chaetoceros gracilis, *Diatoms, *Aquatulture, *Shrimp, *Penaeus stylirostris, *Penaeus vannamei, Chrysophyta, Protozoa, Larvae, Algae, Food chains, Costa Rica, Methodology, Cultures, Foods, Water temperatures, Nutrients, Eutrophication, Mortality.

The solitary diatom *Chaetoceros gracilis* has been successfully cultured as exclusive food for larvae of the protozoans *Penaeus stylirostris* and *P. vannamei*, used to feed shrimp at a commercial hatchery in Costa Rica. High larval survival rates (79.3-84.8%) were obtained in 40-cu m tanks. *C. gracilis* grew vigorously in hatchery tanks at 28-30°C. Techniques were developed to prevent excessive diatom concentrations (over 100,000 cells/ml) which upon collapse caused mass larval mortality, and to prevent inadequately low concentrations (under 30,000 cells/ml) which also killed larvae. Control procedures include: (1) deliberate collapse before stocking, which limits but does not prevent further growth; and (2) simultaneous inoculation and stocking. Diatom levels up to 450,000 cells/ml were suitable for *Penaeus* growth, but above 100,000 cells/ml there was great risk of mortality due to algal collapse. *Skeletonema costatum* use has been declining in recent years in Japanese hatcheries because of difficulties in maintaining the species in larval cultures above 25°C, and the occasional predominance of unsuitable diatom species. Stock solutions of *C. gracilis* were maintained in modified Guillard and Ryther medium f at 25-26°C, without agitation or aeration. New cultures were inoculated after 3-4 days and aerated 3-4 days until a cell count of 3.4 million/ml was reached. Stock solutions were maintained one year without apparent contamination or loss of vigor. (Lynch-Wisconsin) W79-05738

MATHEMATICAL MODEL AND COMPUTER SIMULATION OF THE POPULATION DYNAMICS OF ZOOPLANKTON IN LAKE AND ESTUARY ECOSYSTEMS.
Tennessee Univ., Knoxville. Dept. of Engineering Science and Mechanics.
E. V. Kalmaz.
Ecological Modelling, Vol 5, No 3, p 225-235, September 1978. 1 fig, 20 ref.

Descriptors: *Lakes, *Estuaries, *Zooplankton, *Computer models, *Simulation analysis, *Population dynamics, Mathematical models, Ecosystems, Survival, Food balance, Methodology, Life span, Analytical techniques, Food chains.

A mathematical model represents population dynamics and survival probabilities of zooplankton in lake and estuarine ecosystems. Basic digital computer simulation methodology is used for systematic application of the model to analyze zooplankton

population dynamics. In analysis of this theoretical modelling, attention is focused on the animal's production and destruction processes, both of which are assumed to be stationary. The birth (production) rate is constant and life span distribution is independent of time. It is also assumed that different species are independent, that they share a common aquatic ecosystem, and that what happens to one species sophisticated methods of quantitative analysis to the species is the ultimate solution of food balance problems in an aquatic ecosystem. The fundamental features for the mathematical model and formulations used in predicting distribution and population survival of zooplankton in lakes and estuaries cannot be applied to open ocean systems because the latter have no definable boundaries and cannot be experimentally controlled or manipulated. The direct simulation in this study covers small time increments, dividing the population of zooplankton into small subpopulations, which can be summed to determine total population or the destruction of zooplankton, at a given time. (Lynch-Wisconsin) W79-05739

INFLUENCE OF NON-POINT POLLUTION SOURCES IN CONNECTION WITH THE TUY RIVER BASIN SANITATION STUDIES.
Universidad Central de Venezuela, Caracas.
For primary bibliographic entry see Field 5A.
W79-05740

AN UNUSUAL OCCURRENCE OF HEMIAULUS MEMBRANEACEUS CLEVE (BACILLARIOPHYCEAE) WITH RICHELIA INTRACELLULARIS SCHMIDT (CYANOPHYCEAE) OFF THE COAST OF SOUTHERN CALIFORNIA IN OCTOBER 1976.
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
B. Kimor, F. M. H. Reid, and J. B. Jordan.
Phycologia, Vol 17, No 2, p 162-166, June 1978. 3 fig, 11 ref.

Descriptors: *Hemiaulus membranaceus, *Richelia intracellularis, *Endophytes, *Water temperature, *Phytoplankton, *Marine algae, California, Coasts, Pacific Ocean, Oceans, Algae, Cyanophyta, Diatoms, Chrysophyta, Heterocysts, Trichomes, Filamentous algae, Nitrogen fixation, Nitrogen cycle, Flumes.

An unusual occurrence of cells of the centric diatom *Hemiaulus membranaceus* containing trichomes of the filamentous blue-green alga *Richelia intracellularis*, observed 18 October 1976 in the flume of the S10 pier at La Jolla, California, may be due to higher-than-average water temperature (18.5°C). There was no clear evidence that nitrogen fixation by *Richelia* contributed to phytoplankton production. Sixty-two percent of the *H. membranaceus* cells contained trichomes of *R. intracellularis* with distinct terminal heterocysts and normal vegetative cells. By 20 October cell numbers were declining, the trichomes of *R. intracellularis* being in a state of disintegration with only the translucent terminal heterocysts showing in some cells. Persistence of the senescent heterocyst in the host cell is consistent with other records in which it is shown to outlive the rest of the trichome due to a chemical composition different from that of the vegetative cells; it is considered to be the possible site of molecular nitrogen fixation. Association of *H. membranaceus* and *R. intracellularis* was intermittently observed November 1976-January 1977. Neither the unusual endophytic association nor the occurrence of large numbers of *H. membranaceus* had been previously recorded in the area. The apparently short duration of the *Hemiaulus* occurrence may have been due to transport of the species into the area by warm currents followed by its dying out because of unfavorable nutrient conditions. (Lynch-Wisconsin) W79-05741

ISOLATION, PURIFICATION AND EVIDENCE FOR A HALOPHILIC NATURE OF THE BLUE-GREEN ALGA APHANOTHECE HALOPHYTICA FREY (CHROOCOCCALES).

Southern Illinois Univ. at Carbondale. Dept. of Botany.
J. H. Yopp, D. R. Tindall, D. M. Miller, and W. E. Schmid.
Phycologia, Vol 17, No 2, p 172-178, 1978. 9 fig, 33 ref. NASA NGR-14-008-026.

Descriptors: *Aphanotethece halophytica, *Halophilic organisms, *Cyanophyta, *Salinity, *Halotolerance, Chroococcales, Purification, Isolation, Prokaryotes, Testing procedures, Methodology, Analytical techniques, Osmosis, Sodium chloride, Salts, Evaporation ponds, Algae.

An axenic culture of an extremely halotolerant (and perhaps halophilic) cyanophyte alga, *Aphanotethece halophytica* (Chroococcales) was obtained by means of a multistep purification procedure. If halophilic, it would be the first known axenic culture of a photoautotrophic prokaryote (blue-green alga) that satisfies all criteria for extreme tolerance of saturated brine: (1) optimal growth in high concentrations of sodium chloride, (2) obligate requirement for relatively high levels of this specific salt for survival, (3) lysis in media of less than 5% NaCl, (4) possession of very high intracellular ionic osmoticity, and (5) a requirement for high ionic strength for maintenance of conformation of intracellular proteins. To date such extreme obligate halophilism has only been verified in the bacterial prokaryotes in the families Pseudomonadaceae and Micrococcaceae. The recently reported successful growth of the cyanophyte *Coccolithus elabens* in media containing 20% NaCl and failure to grow in media of less than 5% NaCl suggests halophilism, but purification was unsuccessful. Lysis of the alga reported here in distilled water and in media of less than one M NaCl, and failure of KCl, LiCl, and CsCl to substitute for NaCl suggest the alga is halophilic rather than only halotolerant. Specimens were isolated from a sample of soft sulfide mud from the bottom of the final solar evaporation pond of a salt production company in Redwood City, California in October 1969. (Lynch-Wisconsin) W79-05742

ISOLATION, CHARACTERIZATION AND PATHOLOGY OF THE TOXIN FROM A MICROCYSTIS AERUGINOSA (=ANACYSTIS CYNEA) BLOOM.
Commonwealth Scientific and Industrial Research Organization, Parkville (Australia). Div. of Protein Chemistry.
T. C. Elleman, I. R. Falconer, A. R. B. Jackson, and M. T. Runnegar.
Australian Journal of Biological Sciences, Vol 31, No 3, p 209-218, 1978. 2 tab, 32 ref.

Descriptors: *Microcystis aeruginosa, *Toxins, *Toxicity, *Lethal limit, *Cyanophyta, *Pathology, Algae, Lakes, Reservoirs, Anacystis cyanea, Eutrophication, Amino acids, Chemical analysis, Laboratory tests, Mice, Australia, Malpas Dam Reservoir (Australia), Liver, Chronicity effects, Sublethal effects, Purification, Isolation.

A toxin isolated from a bloom of the blue-green alga *Microcystis aeruginosa* (= *Anacystis cyanea*) in October 1973 at Malpas Dam Reservoir, New South Wales, Australia, has the simplest amino acid composition and highest toxicity of any toxin isolated from *M. aeruginosa*. The pure toxin is about 20 times stronger than hydrogen cyanide or strychnine on a weight basis. Lyophilized crude algal bloom extracts injected intraperitoneally into laboratory mice were lethal (LD100) 15-30 mg/kg and the LD100 at 0.070 mg/kg based on the total material found from amino acid analysis. The liver was the only organ strongly affected; especially noticeable were the extensive liver hemorrhages preceding recognizable hepatocyte degeneration and necrosis (which was never massive). Hemorrhages and death occurred 1-3 hrs after parenteral administration of the purified toxin. Repeated sublethal doses were lethal only after a period of weeks. Purification involved ammonium sulfate fractionation, solvent extraction, acid precipitation, Sephadex G25 and DEAE-Dephadex chromatography, and high-voltage electrophoresis at pH 9.0, had no free amino group, and was character-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

ized by a simple amino acid composition of equimolar quantities of L-methionine, L-tyrosine, D-alanine, D-glutamic acid, erythro beta-methyl aspartic acid, and methylamine. (Lynch-Wisconsin)
W79-05743

BIOLOGICAL EFFECTS OF RICE-FIELD HERBICIDE MACHETE ON VARIOUS STRAINS OF THE NITROGE-FIXING BLUE-GREEN ALGA NOSTOC MUSCORUM.
Banaras Hindu Univ., Varanasi (India). Dept. of Botany.
H. N. Singh, and A. Vaishampayan.
Environmental and Experimental Botany, Vol 18, No 2, p 87-91, May 1978. 4 fig, 3 tab, 33 ref.

Descriptors: *Nostoc muscorum, *Mutation, *Herbicides, *Cyanophyta, *Rice, *Machete, *Toxicity, *Aquatic weed control, Nitrogen fixation, Plant growth, Growth stages, Growth rates, Water pollution effects, Heterocysts, Agriculture, Crop production, Algae, Bioassay, Nitrogen, Fertilization, Fertilizers, Lethal limit, DCMU, Glucose.

The amide preemergent rice-field herbicide under the trade-name 'Machete' (2-chloro-2,6-diethyl-N-(butoxymethyl) acetanilide), was toxic and mutagenic to the blue-green alga *Nostoc muscorum* at 10 micrograms/ml, a dose about one-third of the 27.5 micrograms/ml used in the rice fields (2.5 kg/ha). The higher dose probably causes more damage to the cyanophytes than found in these tests. Nitrogen-fixing blue-green algae are important contributors to rice-field fertility; and fertilization with blue-green algae produces better yields than synthetic nitrogen fertilizers. Machete was toxic and lytic to the parental strain and to two non-nitrogen-fixing mutant strains, designated het(+) nif 11(-) and Em-R het(-) nif 2(-). Intensity of biological effects increased with the growth-promoting efficiency of various inorganic nitrogen sources. The herbicide had no effect on heterocyst differentiation, and induced biological changes were not reversed by glucose. Growth of the three strains was completely inhibited in cultures treated with more than 20 micrograms/ml Machete. At 10 micrograms/ml the parent strain grew slower than controls, and instead of entering the stationary growth phase, lysed at the end of the growth period. Machete appears to be a strong mutagen, as 5-6% of the two mutant strains are prototrophic revertants. The biochemical or molecular mechanism of action of Machete (Monsanto Chemical Company) is largely unknown. (Lynch-Wisconsin)
W79-05744

SALINITY DEPENDENT DISTRIBUTION OF BENTHIC ALGAE IN ESTUARINE AREAS OF ICELANDIC FJORDS.
Slovenska Akademija Znanosti in Umetnosti, Ljubljana (Yugoslavia). Biological Inst.
I. M. Munda.
Botanica Marina, Vol 21, No 7, p 451-468, October 1978. 4 fig, 4 tab, 15 ref.

Descriptors: *Benthic flora, *Algae, *Salinity, *Iceland, *Fjords, *Estuaries, *Distribution, *Intertidal areas, *Estuarine environments, Brackish water, Ecology, Subtidal areas, Zonation, Habitats, Floral lists, Data collections, Borgarfjordur(Iceland), Dyrafjordur(Iceland), Steingrimsfjordur(Iceland), Mjofjordur(Iceland), Reydarfjordur(Iceland), Pylaiella littoralis, Dictyosiphon chordaria, Porphyra purpurea, Enteromorpha, Cladophora, Biological communities.

Salinity ranges are given in tabular form of benthic algae in the estuarine inner areas of six Icelandic fjords. Salinity, along with substrate configuration, is regarded as the major determinant of the distribution of these algae in the fjords. The fjords, whose inner estuarine areas represent salinity gradients from limnic to marine, were: (1) Borgarfjordur in the southwest, (2) Dyrafjordur in the northwest, (3) Steingrimsfjordur in the north, (4) Reydarfjordur in the midwest, (5) Mjofjordur in the midwest, and (6) Berufjordur in the southeast. Each fjord is individually described. Distribution of in-

tertidal and subtidal benthic algae was investigated with regard to individual species, algal associations, and zonal patterns. The salinity barrier between brackish and limnic habitats was pronounced in all fjords. Pioneer species included *Pylaiella littoralis*, *Dictyosiphon chordaria*, *Porphyra purpurea*, and representatives of the genera *Enteromorpha* and *Cladophora*. In most fjords the first benthic vegetation was composed of an association of dwarf *Pylaiella littoralis*. In the mixo-oligohaline zone D. chordaria was the main pioneering species, characterized by a salinity-induced reduction in body size. Chlorophytes predominated in the oligohaliniakum and in most of the mesohaline area. Some typical marine species were able to penetrate into the estuarine areas. Vegetation in the oligohaliniakum was not yet zoned. *Enteromorpha intestinalis* was the pioneer belt-former. (Lynch-Wisconsin)
W79-05745

COMMUNITY STRUCTURE, DYNAMICS AND NUTRIENTS CYCLING IN THE OKEFENOKEE CYPRESS SWAMP-FOREST.
California Univ., Santa Barbara. Dept. of Biological Sciences.
W. H. Schlesinger.
Ecological Monographs, Vol 48, No 1, p 43-65, 1978. 3 fig, 13 tab, 120 ref.

Descriptors: *Okefenokee Swamp(GA), *Swamp forests, *Biological communities, *Cypress trees, *Cycling nutrients, *Biomass, Georgia, Swamps, Forests, Ecology, Ecosystems, Trees, Nutrients, Peat, Taxodium distichum, Primary productivity, Tillandsia, Bogs, Forest fires, Droughts, Acid waters, Litterfall, Leachates, Closed systems, Data collections, Precipitation(Atmospheric), Biochemistry.

The cypress forest of Okefenokee Swamp in southeastern Georgia, is characterized by low nutrient availability and large peat accumulation; trees are mostly pond cypress (*Taxodium distichum*), probably due to recurrent understory fires which eliminate other species. Mean values of living stem density (1465 stems/ha) and total basal area (52 sq m/ha) are high compared to upland forests. Differences in density appear due to forest fires during periodic droughts. Use of dimension analysis techniques show that cypresses comprise 98% of the total above-water forest biomass of 307 metric tons/ha. Most cypress biomass (96%) is in tree boles, with little (0.8%) in foliage. Total above-water net primary productivity is low (692 g/sq m/yr), presumably because of the acid, nutrient-poor conditions. High biomass is the result of the old age (150 yrs) of the stand and high tree density. Cypress net production is largely channeled into bole wood (41%) and current twigs with needles (41%). Nutrient pools in the above-water community are large (666 kg/ha calcium, 111 kg/ha magnesium, 230 g/ha potassium, 996 kg/ha nitrogen, and 46 kg/ha phosphorus), but largely contained in cypress boles, these nutrients do not freely circulate. Foliage abscission and foliar leaching by rainfall return 73-91% of annual nutrient uptake. (Lynch-Wisconsin)
W79-05746

ECOLOGICAL STUDIES ON THE INTERTIDAL ALGAE AT OKHA (INDIA).
Saurashtra Univ., Rajkot (India). Dept. of Biosciences.
M. S. Murthy, M. Bhattacharya, and P. Radia.
Botanica Marina, Vol 21, No 6, p 381-386, August 1978. 6 fig, 14 ref.

Descriptors: *Okha(India), *Intertidal areas, *Ecology, *Algae, *Seasonal, *Zonation, *Littoral, Species composition, Species diversity, India, Coasts, Marine algae, Biomass, Sargassum, Chlorophyta, Phaeophyta, Rhodophyta, Epiphytes, Floral lists, Abundance, Nutrients, Distribution, Dissolved oxygen, Nutrients, Temperature, Water temperature, Gulf of Kutch(India), Arabian Sea.

Intertidal algae was sampled monthly during one growing season (June-February) on the rocky littoral of Okha, Gujarat State, India, (Gulf of Kutch,

Arabian Sea) for biomass fluctuations, zonation, and environmental influences; of 47 species found, Sargassum (Phaeophyceae) was the only recorded throughout the study period and found in all parts of the intertidal zone, and was the most important contributor to total biomass. Phaeophyceae and Rhodophyceae contributed more to total biomass than Chlorophyceae, and maximum diversity was found among Rhodophyceae. Overall species diversity increased from the onset of winter in November, when biological activity was accelerated. Air and seawater temperature and dissolved oxygen content were the critical factors governing distribution and biomass of the algae, but mineral content of the water was not related to biomass accumulation, presumably due to remineralization of nutrients from dead plants and efficient mixing. Land in the study area was arid, and during the summer months of May and June the intertidal belt was almost barren; algal germlings appeared in July, with increased biological activity in November, but by the end of February most algae began drying out, leaving the belt barren in April. Chlorophyceae and Phaeophyceae were abundant in middle and lower parts of the mid-littoral, extending to the infra-littoral fringe. Rhodophyceae were rare up to the upper mid-littoral, but abundant in the infra-littoral fringe and zone. (Lynch-Wisconsin)
W79-05747

FOURTH NATIONAL WORKSHOP ON ENTRAINMENT AND IMPINGEMENT.
Proceedings of a Workshop, December 5, 1977, Chicago, Illinois. Jensen, L.D.(Ed.) Ecological Analysts Communications, Melville, New York. 1978 423 p.

Descriptors: *Conferences, *Entrainment, Environmental effects, Regulation, *Impingement.

This publication of the proceedings of the workshop on Entrainment and Impingement contains a compilation of regulatory and technological information. The publication contains 36 papers which are concerned with regulatory issues, entrainment abundance and survival, impingement studies, impact assessment techniques, and engineering aspects of entrainment and impingement. A report of panel discussions in these areas of interest is also included. (See W79-05755 thru W79-05790) (Chilton-ORNL)
W79-05754

IMPLEMENTATION OF SECTION 316 OF THE FEDERAL WATER POLLUTION CONTROL ACT.
Environmental Protection Agency, Washington, D.C. Permit Program Div.
S. L. Bugbee.
In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois p 3-5, 1978.

Descriptors: *Environmental effects, *Regulation, Thermal pollution, Water pollution, Electric power industry, Environmental Protection Agency.

The Federal Water Pollution Control Act of 1972 states an intention 'to restore and maintain the chemical, physical, and biological integrity of the Nation's water.' With the characterization of heat as a pollutant, the steam electric industry was brought under coverage of this act. Section 316(a) of the act governs thermal discharges and Section 316(b) governs cooling water intakes. The paper discusses these two provisions in the light of their relationships and provides an overview of U.S. EPA regulatory programs covering the steam electric industry. (See also W79-05754) (Chilton-ORNL)
W79-05755

THE POWER PLANT REGULATORY PROGRAM: A CONGRESSIONAL DILEMMA.
Committee on Public Works and Transportation (U.S. House).
C. A. Krouse.

Effects Of Pollution—Group 5C

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 7-9, 1978.

Descriptors: *Environmental effects, Regulation, Electric power industry, Thermal pollution, Entrainment, Legislation, Aquatic life, Impingement.

Section 316 of Public Law 92-500 is discussed in light of the difficulties inherent in using the legal advisory system to resolve complicated environmental issues. An overview of a report by the Subcommittee on Investigations and Review focuses on the judgemental character of power plant regulation and raises questions concerning interpretation of language used in Section 316. The conflict over legality and common sense is discussed. (See also W79-05754) (Chilton-ORNL) W79-05756

REGULATORY DEVELOPMENTS IN SECTION 316(B),

Environmental Protection Agency, Chicago, IL. Enforcement Div. G. S. Milburn, and G. C. Ginsberg.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 11-20, 1978.

Descriptors: *Environmental effects, *Regulation, *Electric power industry, Thermal pollution, Entrainment, Legislation, Aquatic life, Intakes.

An overview of recent legal and technical developments and their impact on application of Section 316(b) is provided. Implications of decisions in the Seabrook, Brunswick, Wabash River and Cayuga proceedings are discussed as well as the potential application of the ruling in the U.S. Steel v. Train case. Section 316(b) determinations and the technical basis for each for Quad Cities, Dresden, and Prairie Island nuclear power plants and a proposed addition to a fossil facility, Campbell Unit 3, are discussed. Emphasis is placed upon the need for basin- or lakewide evaluation of intake effects and the need for long-term baseline data to assess impacts of power plants. Positive rulings of Section 316(b) are summarized and future directions are discussed. (See also W79-05754) (Chilton-ORNL) W79-05757

THE ROLE OF THE SCIENTIST IN THE SECTION 316 PROCESS: A LAWYER'S POINT OF VIEW,

LeBoeuf, Lamb, Leiby and MacRae, New York. G.S.P. Bergen.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 21-24, 1978 2 ref.

Descriptors: *Environmental effects, *Legislation, Technology, Political aspects, Economics, Water pollution, Entrainment, Electric power industry.

It is suggested that the basic role of the scientist is to use his specialized knowledge to assist in making reasonable choices. Scientists, in addition to developing new technologies, must participate in the regulation of those technologies. A responsibility is placed upon the scientist to make sound practical judgments involving not only scientific decisions, but also economic and political factors. (See also W79-05754) (Chilton-ORNL) W79-05758

EVALUATION OF ICHTHYOPLANKTON SAMPLING GEAR USED IN POWER PLANT ENTRAINMENT STUDIES,

Virginia Inst. of Marine Science, Gloucester Point. R. R. Bowles, and J. V. Merriner.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 33-43, 1978 2 fig 2 tab 70 ref.

Descriptors: *Environmental effects, *Entrainment, *Sampling, Aquatic populations, Plankton.

Objectives of this study were to describe types of gear in current use for ichthyoplankton sampling,

to determine biotic and abiotic factors affecting sampling accuracy, to assess gear accuracy in obtaining representative samples, and to recommend features to be optimized. A nationwide listing of sampling gear in use has been compiled and indexed by aquatic ecosystem type. Factors associated with sampling accuracy include gear design, efficiency, and deployment. Physical/chemical factors and site-specific characteristics are also of importance. Biotic factors affecting accuracy include avoidance, distribution and habitat utilization by aquatic life. It is recommended that sampling gear selection should be critically reviewed as an important element of the total sampling program design. It was concluded that prediction and detection of entrainment related impact has been obscured by incompatibility of data from different sampling gear. The importance of a continuous historical record of population dynamics is emphasized. (See also W79-05754) (Chilton-ORNL) W79-05759

ENTRAINMENT OF MISSOURI RIVER FISH LARVAE THROUGH FORT CALHOUN STATION,

NALCO Environmental Sciences, Lincoln, NE. R. G. King.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 45-56, 1978 5 fig, 4 tab, 17 ref.

Descriptors: *Environmental effects, *Entrainment, Larvae, Fish, Missouri River, Thermal stress, Mortality, Electric power industry, Powerplants.

These studies documented larval fish species composition, abundance, and distribution in the Missouri River. Potential impact on game fish and important commercial fish was low because larvae of these fish made up a low percentage of the entrained ichthyoplankton. Catostomids were entrained throughout the larval season but over 50% survived condenser passage. Freshwater drum accounted for 75% of the entrained larvae; 96% of the larvae collected in the discharge were dead. Entrainment effects were due to both mechanical and thermal stresses. Mixing characteristics of the submerged discharge, rapid dissipation of heat, short exposure to plume temperatures and the low percentage of water used for cooling reduced the potential impact of plume entrainment. The Station entrained 2.1 to 12.4% of the larvae passing the Station. Estimated losses ranged from 2.6 to 5.3% of the total larval assemblage. (See also W79-05754) (Chilton-ORNL) W79-05760

MORTALITY OF YOUNG STRIPED BASS ENTRAINMENT AT TWO POWER PLANTS IN THE SACRAMENTO-SAN JOAQUIN DELTA, CALIFORNIA,

California State Dept. of Fish and Game, Stockton.

D. E. Stevens, and B. J. Finlayson.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 57-69, 1978 4 fig, 6 tab, 9 ref.

Descriptors: *Environmental effects, *Entrainment, Striped bass, Fish, Thermal stress, Mortality, Electric power industry, Powerplants, Cooling water.

Mortality estimates for young striped bass of approximately 8 to 31 mm in length were based on differences between percentages of bass alive at the intakes and discharges. Plots of mortality estimates versus discharge temperatures and delta-Ts suggested that heat did not kill bass until discharge temperatures exceeded 31 C and delta-Ts exceeded 7 C. Mean estimates of mortality owing to entrainment at lower temperatures were 13.8 and 10.8%. Mortality estimates increased linearly to 100% with discharge temperature from about 31 to 38 C and delta-Ts from 7 to 17 C. (See also W79-05754) (Chilton-ORNL) W79-05761

SURVIVAL OF ENTRAINMENT ICHTHYOPLANKTON AND MACROINVERTEBRATES AT HUDSON RIVER POWER PLANTS,

Ecological Analysis, Inc., Middletown, NY. T. C. Cannon, S. M. Jinks, L. R. King, and G. J. Lauer.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 71-89, 1978 6 fig, 15 tab, 13 ref.

Descriptors: *Environmental effects, *Entrainment, Mortality, Hudson River, Fish, Larvae, Invertebrates, Thermal pollution, Thermal stress, Electric power industry, Powerplants.

Entrainment survival studies conducted at six Hudson River powerplants indicated that entrainment mortality is minimal when discharge temperatures are maintained below lethal thermal thresholds. Laboratory data on striped bass, white perch, and Clupeidae larvae indicated threshold thermal tolerance limits at about 32 C with 10 minute TL50s of 33 to 36 C. For ichthyoplankton, high mortalities attributable to thermal stress were observed at the plants at temperatures above 30 C. For most macroinvertebrates, entrainment mortality was not observed except extreme under extreme summer conditions (discharge temperatures of 35 C or higher). (See also W79-05754) (Chilton-ORNL) W79-05762

SURVIVAL OF PLANKTONIC ORGANISMS FOLLOWING PASSAGE THROUGH A SIMULATED POWER PLANT CONDENSER TUBE,

Tetra Tech, Inc., Lafayette, CA. T. C. Ginn, G. V. Poje, and J. M. O'Connor.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 91-101, 1978 8 fig, 3 tab, 15 ref.

Descriptors: *Environmental effects, *Entrainment, Thermal pollution, Thermal stress, Electric power industry, Fish, Larvae, Plankton, Cooling water, Temperature, Pressure, Flow, Velocity, Chlorination.

A power plant condenser tube simulator was designed which can test organisms reaction to the velocities, temperature changes, biocide concentrations, and pressure changes which are encountered in a condenser tube during pumped entrainment. Test organisms used in these studies were striped bass larvae (*Morone saxatilis*), carp (*Cyprinus carpio*), phantom midge larvae (*Chaoborus americanus*), and the estuarine amphipod *Gammarus tigrinus* tests using the simulator showed that at sublethal temperatures there were no detectable lethal effects of passage on the species tested. Interactive effects between individual stresses were observed at or near lethal exposure temperatures. Reduced survival of *Chaoborus* larvae was seen at a combination of subatmospheric pressure and near-lethal temperature. Supra-additive interactions were observed between chlorine and temperature/condenser stresses for both *Gammarus* and striped bass larvae. Results of studies indicate that the magnitudes of net collection mortalities are dependent on temperature. (See also W79-05754) (Chilton-ORNL) W79-05763

MODELS USEFUL FOR THE ESTIMATION OF EQUILIBRIUM POPULATION REDUCTION DUE TO POWER PLANT CROPPING,

Lawler, Matusky and Skelly, Pearl River, NY. J. P. Lawler, and T. L. Englert.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 103-113, 1978. 15 fig, 15 ref.

Descriptors: *Environmental effects, *Entrainment, *Model studies, Forecasting, Populations, Electric power industry, Powerplants, Cooling water.

The objective of this paper is to present means of estimating the effect of water withdrawal on long-term equilibrium populations. The analysis presented includes approaches for estimating the compen-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

satory response of biological populations to entrainment impact. Extensions of the Ricker and Beverton-Holt analyses (including application of Ricker's analysis to a multiple-age spawning population, a dissection of Ricker's alpha into its component parts in a multiple-age spawning population, and modification of Ricker's equation to include the effects of additional system stresses on Ricker's beta) are considered. A general increase in the level of compensatory response in comparison with the level obtained using the classical Ricker model is indicated. The study indicates that the ultimate level of impact caused by operation of once-through cooling may even result in a net population increase. (See also W79-05754) (Chilton-ORNL) W79-05764

A METHOD FOR DETERMINING GROWTH AND MORTALITY RATES OF ICHTHYOPLANKTON.
Tennessee Valley Authority, Norris Div. of Forestry, Fisheries, and Wildlife Development.
P. A. Hackney, and J. C. Webb.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, Illinois. p 115-124, 1978 8 fig, 4 tab, 4 ref, 1 append.

Descriptors: *Environmental effects, *Entrainment, *Model studies, Larvae, Mortality, Growth rate, Plankton, Fish.

This work is a study of differential equations that describe the growth-mortality dynamics of larval fish populations. By enumerating by length class of taxonomic groups, average growth rate of ichthyoplankton hatched over a spawning season can be determined from samples taken throughout the season. Numbers of a given length class for a species typically form a distribution through time. The mean of these distributions occurs progressively later in the year for increasing length groups and is the date on which the average individual achieved the length in question. A plot of these dates against the corresponding length groups yields a graph from which the growth rate can be determined. Mortality rate can also be determined from these data. The area under the time-frequency distribution curve is the total number of larvae of that length class which occurred during the year. Since time required to grow to succeeding length classes has been determined, a plot of total numbers by size class against the date the average individual achieved that length yields a graph from which mortality rate coefficient can be determined. (See also W79-05754) (Chilton-ORNL) W79-05765

EFFECTS OF THE DONALD C. COOK NUCLEAR POWER PLANT ON ZOOPLANKTON OF SOUTHEASTERN LAKE MICHIGAN.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans, B. E. Hawkins, and T. E. Wurster.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, Illinois. p 125-139, 1978 12 fig, 3 tab, 13 ref.

Descriptors: *Environmental effects, *Entrainment, Thermal pollution, Zooplankton, Electric power industry, Water pollution, Nuclear powerplants.

An overview of the preoperational and operational zooplankton monitoring program at the plant are provided. Data from the monitoring program show that a maximum of 12% of entrained zooplankton were killed by condenser passage and that there was no evidence of delayed mortality within 24 hours after passage. It was concluded that the once-through cooling system in use at this plant seems to be effective in minimizing the effects of thermal pollution in the receiving water. This is accomplished primarily by operating at discharge temperatures only 10 C above ambient lake temperatures and by rapidly mixing condenser-passed water into the lake through the use of a jet rather than a canal. The location of the plant on a large body of water is also an important factor in reducing the environmental effects of discharging large

volumes of heated water. (See also W79-05754) (Chilton-ORNL) W79-05766

ENTRAINMENT OF CRUSTACEAN ZOOPLANKTON THROUGH FORT CALHOUN STATION.
NALCO Environmental Sciences, Lincoln, NE.
G. D. Rogers.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, Illinois. p 141-154, 1978 5 fig, 6 tab, 20 ref.

Descriptors: *Environmental effects, *Entrainment, Thermal stress, Water pollution, Thermal pollution, Electric power industry, Cooling water, Zooplankton, Mortality, Nuclear powerplants.

This report documents the results of a monitoring program conducted from October 1973 through June 1977. Copepoda generally accounted for >75% of the total zooplankton. Entrainment losses averaged 3.7% immediately after passage (0 hours), 2.8% at 4 hours, and 3.8% at 24 hours. Thermal stress was apparently the principal factor in reducing zooplankton motility at 0 hours. Mechanical stress accounted for an average increase in immotility of 1.1%. Entrainment losses were high when absolute discharge temperatures were > or = 35C. Viability was generally not dependent on delta-T. Losses for the total river zooplankton community resulting from Station operation did not exceed 0.6% on any sampling date. (See also W79-05754) (Chilton-ORNL) W79-05767

MACROINVERTEBRATE ENTRAINMENT STUDY AT FORT CALHOUN STATION.
NALCO Environmental Sciences, Lincoln, NE.
S. R. Carter.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, Illinois. p 155-169, 1978 5 fig, 6 tab, 34 ref.

Descriptors: *Environmental effects, *Entrainment, Thermal stress, Invertebrates, Missouri River, Mortality, Electric power industry, Cooling water, Water pollution, Thermal pollution.

Samples of drifting macroinvertebrates were collected twice monthly from October 1973 to June 1977. Samples were comprised of Hydropsychidae (37%), Chironomidae (24%), Heptageniidae (8%), and Caenidae (6%). Differential mortality for the entrained drift assemblage ranged from 0.0 to 18.2% and average 7.7% during the study. Differential mortalities on operational sampling dates averaged 8.6%; losses during shutdown periods averaged 3.4%. Entrainment losses resulted primarily from thermal stress with losses averaging as high as 10% during periods of high absolute discharge temperatures (32 to 37 C). It was concluded that, assuming uniform drift distribution in the river, mortality for the total assemblage increased an average of 0.2% as a result of entrainment. (See also W79-05754) (Chilton-ORNL) W79-05768

EFFECTS OF ACUTE THERMAL STRESS ON MARINE FISH EMBRYOS AND LARVAE.
National Marine Fisheries Service, Beaufort, NC.
Beaufort Lab.
W. F. Hettler, and L. C. Clements.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, Illinois. p 171-190, 1978 8 fig, 10 tab, 6 ref.

Descriptors: *Environmental effects, *Entrainment, Thermal stress, Water pollution, Marine fish, Larvae, Embryonic growth stage, Electric power industry, Cooling water.

Investigations were conducted to determine survival of embryos and larvae of spot (*Leiostomus xanthurus*) and black sea bass (*Centropristis striata*). Developmental stages tested were prelarval, early- and mid-embryo, and five larval ages up to 30 days old. Acclimation temperatures were 16, 20, and 24 C. Delta-Ts of 8-14 C were chosen

for 16 C acclimation, 6-12 C for 20 C, and 4-10 C for 24 C. Pregastrula spot were found to be more susceptible to thermal stress than later embryonic stages. Spot larvae showed no relationship between age and survival following exposures of up to 12 C above ambient temperatures. Black sea bass showed similar mortalities at both early and late embryonic stages. Embryos slowly returned to ambient temperatures after exposure to thermal stress showed increased survival over those rapidly cooled. (See also W79-05754) (Chilton-ORNL) W79-05769

IMPACTS OF THREE TYPES OF POWER GENERATING DISCHARGE SYSTEMS ON ENTRAINMENT PLANKTON.
Beak Consultants Ltd., Mississauga (Ontario).
R. W. Crippen, F. K. Fahmy, B. Seepersad, and A. M. Hayton.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, Illinois. p 191-202, 1978 5 fig, 5 tab, 19 ref.

Descriptors: *Environmental effects, *Entrainment, Plankton, Phytoplankton, Fish, Larvae, Thermal stress, Water pollution, Discharge(Water), Design, Cooling water, Electric power industry, Zooplankton.

Using field observations and laboratory entrainment simulations, the responses of phytoplankton, zooplankton, and ichthyoplankton to onshore, offshore, and tempering discharge systems were evaluated. A wide range of delta-Ts for each discharge system were simulated. A critical temperature range (ambient temperature + delta-T) was found to cause a reduction in primary production in phytoplankton and increased mortality in zooplankton but no significant differences were found among the three systems tested. A seasonal shift in tolerance to the critical temperature was noted for both phytoplankton and zooplankton. Results of tests of fish larvae of five species exposed to simulated thermal regimes indicated a significant difference among the discharge systems at effective delta-Ts with the tempering system being the least harmful. (See also W79-05754) (Chilton-ORNL) W79-05770

MORTALITIES OF THE LARVAE OF TWO SPECIES OF BIVALVES AFTER ACUTE EXPOSURE TO ELEVATED TEMPERATURE.
Maine Univ., Walpole. Ira C. Darling Center for Research Teaching and Service.
S. L. Barker, and J. R. Stewart.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, Illinois. p 203-210, 1978 4 fig, 5 tab, 22 ref.

Descriptors: *Environmental effects, *Entrainment, Thermal stress, Larvae, Mollusks, Mortality, Cooling water, Electric power industry, Temperature.

The effect of short-term exposures to elevated temperature on the larvae of *Mytilus edulis* and *Mya arenaria* are described. The larvae were subjected to differing levels of temperature increase for exposure times of from 5 to 180 minutes in a thermal gradient apparatus. Organisms were held for 24 hours after exposure to allow for delayed mortality. Thermal tolerances of the larvae increased from cleavage to straight-hinge stage. It was suggested that the water temperature at the time of spawning may be important in determining whether bivalve larvae survive the thermal shock of passing through a condenser cooling water system. The combination of ultimate exposure temperature and the period of exposure are both important factors in larval survival. (See also W79-05754) (Chilton-ORNL) W79-05771

IMPINGEMENT SURVIVAL STUDIES ON WHITE PERCH, STRIPED BASS, AND ATLANTIC TOMCOD AT THREE HUDSON RIVER POWER PLANTS.
Ecological Analysts, Inc., Middletown, NY.
L. R. King, J. B. Hutchison Jr, and T. G. Huggins.

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In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 217-233, 1978 14 fig. 11 tab, 12 ref.

Descriptors: *Environmental effects, *Screens, Intakes, Mortality, Powerplants, Electric power industry, Fish, Intakes structures, *Impingement.

Impinged fish were collected from the screenwash discharge at Bowline Point, Roseton, and Danshammer Point Generating Stations. Three modes of traveling screen operation were tested: continuous wash, 2-hour hold, and 4-hour hold. The studies showed that there generally is an increase in survival associated with decreased time between screenwashes. Highest probabilities of initial and latent survival of young of the year white perch and striped bass were generally observed for the continuous screenwash mode. Survival probability of Atlantic tomcod was high at Roseton and Danshammer Point plants regardless of screenwash pressure or mode. It was concluded that reducing the impingement stress at the intake structure by either modifying the traveling screens or their mode of operation could reduce or eliminate mortalities for all three species. (See also W79-05754) (Chilton-ORNL) W79-05772

SURVIVAL OF FISHES AND MACROINVERTEBRATES IMPINGED AT OYSTER CREEK GENERATING STATION,

Ichthyological Associates, Inc., Forked River, NJ. T. R. Tatham, D. L. Thomas, and G. J. Miller. In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 235-243, 1978 5 fig, 3 tab, 10 ref.

Descriptors: *Environmental effects, *Screens, Intakes, Intakes structures, Mortality, Fish, Invertebrates, Electric power industry, Powerplants, *Impingement.

The rate of survival and mortality for impinged fishes and macroinvertebrates was found to vary widely by species. Overall, organisms that have been traditionally regarded as hardy had relatively good survival while fishes that are traditionally difficult to collect and handle in good condition had poor survival. Organisms having a hard exoskeleton, bony plates or a defensive mechanism had high immediate survival. Some seasonal variation was observed. Preliminary data suggested that continuous operation of the traveling screens increased survival and decreased mortality. (See also W79-05754) (Chilton-ORNL) W79-05773

AN ANALYSIS OF FACTORS INFLUENCING THE IMPINGEMENT OF THREADFIN SHAD AT POWER PLANTS IN THE SOUTHEASTERN UNITED STATES,

Oak Ridge National Lab., TN. Environmental Sciences Div. J. M. Loar, J. S. Griffith, and K. D. Kumar.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 245-255, 1978 2 fig, 5 tab, 8 ref.

Descriptors: *Environmental effects, *Screens, Intakes, Intakes structures, Electric power industry, Fish, Powerplants, Mortality, *Impingement, Shad.

Data on intake design and location, plant operating procedures, water quality, numbers of fish impinged, and sampling procedures were analyzed for 27 fossil-fueled and 5 nuclear power plants. Young of the year and yearling threadfin shad accounted for the majority of fish impinged. Important parameters influencing shad impingement were water temperature and the distribution and abundance of shad in the cooling water source. Maximum impingement rates occurred in winter when intake temperatures dropped below 10C. (See also W79-05754) (Chilton-ORNL) W79-05774

COMPARATIVE FISH IMPINGEMENT AT TWO ADJACENT WATER INTAKES ON THE MID-COLUMBIA RIVER,

Battelle Pacific Northwest Labs., Richland, WA. Ecosystems Dept.

T. L. Page, D. A. Neitzel, and R. H. Gray. In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 257-266, 1978 8 fig, 4 tab, 5 ref.

Descriptors: *Environmental effects, *Screens, Fish, Fish behavior, Mortality, Columbia River, Electric power industry, Intakes, Intakes structures, *Impingement.

This paper compares fish impingement at two adjacent water intakes located about 276 m apart at River Mile 380 on the Columbia River. Collections from traveling screens at Station A yielded a total of 89 chinook fry while 766 chinook fry were collected from Station B during the same period. Impingement of 10 other species was similar at both intakes except that Station B impinged twice as many yellow perch as did Station A. It was suggested that subtle differences in forebay configuration, curtain wall location, and possible differences in fish behavioral responses to the two facilities may be responsible for the differences in impingement between the two facilities. (See also W79-05754) (Chilton-ORNL) W79-05775

STATISTICAL COMPARISON AND CHOICES OF SAMPLING DESIGNS FOR ESTIMATING FISH IMPINGEMENT AT COOLING WATER INTAKES,

Argonne National Lab., IL. I. P. Murarka, S. A. Spigarelli, and D. J. Bodeau. In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 267-279, 1978 10 fig, 5 tab, 10 ref.

Descriptors: *Environmental effects, *Screens, Sampling, Mortality, Model studies, Fishkill, Intakes, Intakes structures, Powerplants, Forecasting, *Impingement.

The efficiencies and statistical properties for estimating fish kills of six sampling designs are compared and recommendations are made. The stratified systematic random and the stratified random sampling scheme appear to be the most appropriate for use in estimating fish impingement at cooling water intakes. It is recommended that sampling intensity should be between 75 and 180 days per year. Regardless of the sampling design used, the maximum sampling should be conducted during the time periods when variability in day-to-day fish kills is very large. (See also W79-05754) (Chilton-ORNL) W79-05776

TEMPORALLY STRATIFIED SAMPLING PROGRAMS FOR ESTIMATION OF FISH IMPINGEMENT,

Oak Ridge National Lab., TN. Environmental Sciences Div. K. D. Kumar, and J. S. Griffith.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 281-289, 1978 2 fig, 8 tab, 9 ref.

Descriptors: *Environmental effects, *Screens, *Monitoring, Sampling, Seasonal, Temporal distribution, Freshwater fish, Electric power industry, Powerplants, Cooling water, Intakes, Intakes structures, *Impingement.

This paper is concerned with the estimation of the annual rate of impingement when impingement counts exhibit temporal patterns. Monitoring programs were designed to meet two situations: (1) when prior data on impingement were available and (2) when no impingement data were available but counts were known to be correlated with some other parameter such as water temperature. Data gathered from 32 generating stations throughout the southeastern United States showed that a temporally stratified sampling program can be used to obtain reliable estimates of annual impingement

rates. Of the possible temporal patterns within a calendar year, it was found that differences between seasons were most influential in impingement of freshwater fishes. (See also W79-05754) (Chilton-ORNL) W79-05777

A CONCEPTUAL MODEL OF CAUSAL FACTORS REGARDING GIZZARD SHAD RUNS AT STEAM ELECTRIC POWER PLANTS,

Detroit Edison Co., MI. Engineering Research Dept. P. J. Eisele, and J. F. Malaric.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 291-298, 1978 6 fig, 2 tab, 5 ref.

Descriptors: *Environmental effects, *Screens, *Model studies, Monitoring, Fish, Streams, Intakes, Intakes structures, Electric power industry, Powerplants, *Impingement, Shad, Fish runs.

During three years of continuous fish collection using a fish pump at the Monroe Power Plant, various environmental parameters (power plant operating conditions, water quality, and weather conditions) were measured. These parameters were used in regression analysis to determine their effect on shad runs. Data indicated that only water transparency contributed significantly to variations in shad density. Most runs occurred during warm-water recirculation. Causal relationships are identified through the use of a conceptual model. (See also W79-05754) (Chilton-ORNL) W79-05778

EFFECT OF ENVIRONMENTAL VARIABLES ON FISH IMPINGEMENT,

State Univ. of New York at Buffalo. Dept. of Biology. W. S. Lifton, and J. F. Storr.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois. p 299-311, 1978 15 fig, 27 ref.

Descriptors: *Environmental effects, *Intakes structures, Fish, Screens, Electric power industry, Powerplants, Seasonal, Temperature, Winds, Waves(Water), Precipitation(Atmospheric), Cloud cover, *Impingement.

These studies were conducted at C. R. Huntley Power Station which employs a shoreline intake system and at R.E. Ginna Power Station which uses an offshore intake. Results of the study indicated that there are a number of reasons for variation in impingement besides normal seasonal migrations. Important factors were wave height, water temperature, wind direction, sky cover and precipitation, and wind speed. These factors affected impingement of fish at both offshore and onshore intakes. It was also found that fish may use the lee side of an offshore intake as shelter during high winds. (See also W79-05754) (Chilton-ORNL) W79-05779

POSSIBILITIES FOR ASSESSMENT OF THE EFFECTS OF POWER PLANT OPERATION AT THE ECOSYSTEM LEVEL,

Lawler, Matusky & Skelly, Pearl River, NY. E. K. Pikitch, R. A. Alevaras, J. M. Hillegas, Jr., and D. T. Logan. In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, IL. p 315-320, 1978. 7 ref.

Descriptors: *Environmental effects, *Assessments, Powerplants, Electric power industry, Ecosystems.

This paper describes progress on a project to develop guidelines and procedures applicable to ecosystem-level impact analysis. It is suggested that a bilevel approach, which evaluates ecosystems from the different points of view of macroscopic parameters and species interactions, is the best approach. Several macroscopic parameters and analytical approaches which are discussed are persistence, resiliency, diversity, community analysis, loop analysis,

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Group 5C—Effects Of Pollution

and the mean length and size frequency distribution of planktonic organisms. The use of microcosm experiments and computer simulation models was suggested for implementation of the species interaction approach. (See also W79-05754) (Chilton-ORNL)
W79-05780

A MATHEMATICAL MODEL OF THE INTERACTIONS OF AN AQUATIC ECOSYSTEM AND A THERMAL POWER STATION COOLING SYSTEM,

Tetra Tech, Inc., Lafayette, CA.
K. F. Haven, and T. C. Ginn.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, IL. p 321-341, 1978. 10 fig, 14 tab, 68 ref.

Descriptors: *Model studies, *Environmental effects, *Assessments, *Powerplants, Electric power industry, Ecosystems, Aquatic environments.

Methodology for the model described provides stepwise guidance, decision making criteria, analytical models, and an analysis of available data collection methods. It is designed to be used as a long-range planning tool for the design and location of proposed power plants so that either total power output can be maximized subject to aquatic constraints or aquatic ecosystem impacts can be minimized subject to power production constraints. Five basic analytical elements supporting the methodology are presented: a series of hydrodynamics models, a water quality and ecosystem model, population dynamics models, a planning and system optimization model, and the power plant assessment model. The ecosystem model acts as the central integration and assessment tool. The power plant assessment model acts as the primary driving force for the ecosystem level assessment by providing a detailed assessment of the interaction of each segment of a power plant and the local aquatic environment. (See also W79-05754) (Chilton-ORNL)
W79-05781

AN APPROACH FOR THE ANALYSIS OF STRIPED BASS ENTRAINMENT SURVIVAL AT HUDSON RIVER POWER PLANTS,

Ecological Analysts, Inc., Middletown, NY.
S. M. Jinks, T. Cannon, D. Latimer, L. Claffin, and G. Lauer.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, IL., p 343-350, 1978.

Descriptors: *Environmental effects, *Entrainment, Striped bass, Mortality, Electric power industry, Powerplants, Hudson River, Model studies, Thermal stress.

Studies have shown that a high percentage of striped bass are capable of surviving the entrainment experience when the temperature of the circulating water system is below lethal limits, and that mortality increases concurrently with elevation in discharge temperature above these limits. Thermal exposure factors considered in this study were ambient water temperature, delta-T of circulating water, and transit time. These factors were dependent on season, plant generating load, and circulating water flow rate. Mechanical effects on entrainment survival were determined from field entrainment studies. Thermal effects were described by regression models based on thermal laboratory results and on incorporating dependence on acclimation temperature and exposure duration. (See also W79-05754) (Chilton-ORNL)
W79-05782

PERSPECTIVES ON FISH IMPINGEMENT, ARGONNE NATIONAL LAB., IL. DIV. OF ENVIRONMENTAL IMPACT STUDIES.

R. K. Sharma.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, IL. p 351-356, 1978.

Descriptors: *Environmental effects, *Intakes structures, Screens, Fish, Monitoring, Sites, Design, Electric power industry, Powerplants, *Impingement.

This paper examines the objectives of fish impingement studies, monitoring programs, variables affecting fish impingement, siting and design criteria, the state of the art of screening systems, and suggestions for meeting 316(b) requirements. It is suggested that future emphasis in fish impingement related matters should include study of siting and design criteria; a ranking of intake screening systems for biological effectiveness and engineering feasibility; monitoring programs which would consider fish kill as related to population level impacts; redirection of funds and resource to technology development; and a revision of 316(b) guidelines. (See also W79-05754) (Chilton-ORNL)
W79-05783

DOCUMENTATION OF DATA AND LITERATURE RELEVANT TO THE ASSESSMENT OF THERMAL POWER PLANT COOLING SYSTEM EFFECTS ON AQUATIC ENVIRONMENTS,

Atomic Industrial Forum, Inc., Washington, DC.
E. H. Hannon, and R.F. Carrier.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, IL. p 357-359, 1978.

Descriptors: *Data collections, *Data storage and retrieval, Bibliographies, *Environmental effects, Aquatic life, Powerplants, Thermal powerplants, Cooling water, Entrainment, Chemical wastes, Impingement.

The bibliographic computer data base reported here covers the subject areas of thermal effects, chemical effects, impingement, and entrainment. Both open and gray literature are included in the data base which became available for search and retrieval by industry in 1978. (See also W79-05754) (Chilton-ORNL)
W79-05784

ENGINEERING IMPLICATIONS OF NEW FISH SCREENING CONCEPTS,

Stone and Webster Engineering Corp., Boston, MA.

For primary bibliographic entry see Field 8I.

W79-05785

PRELIMINARY STUDIES ON THE OPERATING ASPECTS OF SMALL SLOT WIDTH WEDGEWIRE SCREENS WITH CONCEPTUAL DESIGNS FOR POWER STATION USE,

United Engineers and Constructors, Inc., Philadelphia, PA.

For primary bibliographic entry see Field 8I.

W79-05787

A PRACTICAL INTAKE SCREEN WHICH SUBSTANTIALLY REDUCES THE ENTRAINMENT AND IMPINGEMENT OF EARLY LIFE STAGES OF FISH,

Ichthyological Associates, Inc., Middletown, DE.

For primary bibliographic entry see Field 8I.

W79-05788

CHEMISTRY OF PHOSPHORUS, CADMIUM, COPPER, NICKEL, LEAD, AND ZINC IN INDIANA LAKE AND RESERVOIR SEDIMENTS,

Purdue University Water Resources Research Center, West Lafayette, Indiana.

For primary bibliographic entry see Field 5B.

W79-05794

A REVIEW OF PHYTOPLANKTON STUDIES IN LAKE LIVINGSTON, TEXAS,

Trinity River Authority, Arlington, TX. Planning and Environmental Management Div.

K. C. Rudy.

The Texas Journal of Science, Vol. 30, No. 3, p 273-282, September 1978. 3 fig, 2 tab, 19 ref.

Descriptors: *Lake Livingston(TX), *Reservoirs, *Phytoplankton, *Eutrophication, *Limiting factors, *Primary productivity, *Reviews, Chlorophyll, Lakes, Trinity River(TX), Texas, Rivers, Carbon radioisotopes, Bioassay, Nitrogen, Phosphorus, Nutrients, Water pollution sources, Water pollution effects, Abundance, Seasonal, Data collections.

Phytoplankton-related studies conducted in Lake Livingston, a eutrophic reservoir on the Trinity River, Texas fall into two general categories: (1) primary productivity measurements, and (2) limiting nutrient studies. The first group used chlorophyll-a, cell enumerations, and carbon-14 to measure phytoplankton abundance and productivity. The limiting nutrient experiments were all variations of the nutrient spike, emphasizing nitrogen and phosphorus. Lake Livingston has exhibited numerous eutrophic symptoms since impoundment was completed in November 1971, due mainly to high nutrient input from the Trinity River. Symptoms include anoxic summer hypolimnia, large diurnal DO variations, and proliferation of phytoplankton and macrophytes. In a 1973 study (McCullough 1976) mean productivity was determined at 70.9 mg C/cu m/hr, ranging from 0.8 mg in May to 358.6 mg in July, both extremes in the upper part of the reservoir. Mean chlorophyll-a concentration was 24.6 micrograms/l, with a maximum of 69.4 micrograms on 30 August. There was a highly significant correlation between chlorophyll-a and primary productivity. A study in 1974 (EPA 1977) showed phytoplankton cell counts ranged from one million/l in November to over 15 million in May. A 1969-70 study (Huang, et al. 1973) concluded that nitrogen was limiting in summer in the main part of the reservoir, but available phosphorus regulated growth of the dominant cyanophytes in late summer. (Lynch-Wisconsin)
W79-05806

PHYSIOLOGICAL EFFECTS OF 2,4-D AND 2,4,5-T ON SELECTED AQUATIC ORGANISMS,

Clemson Univ., SC. Dept. of Zoology.
C. F. Sigmon.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 539. Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute, Clemson University, Report No 75, April 1979, 22 p. 6 tab, 19 ref. OWRT A-038-SC(1).

Descriptors: Sublethal effects, Bioconcentration, Water pollution effects, Aquatic animals, Herbicides, 2,4-D, 2,4,5-T, Chironomids, Bluegill, Daphnia.

The sublethal effects of 2,4-D and 2,4,5-T (butoxyethanol esters) on several aquatic animals were examined. The herbicide did not significantly affect oxygen consumption in *Lepomis macrochirus* (bluegill) exposed to 3 ppm. Little herbicide was retained by fish which were exposed to 3 ppm of 2,4-D or 2,4,5-T for eight days. *Daphnia pulex* exhibited greater oxygen consumption when exposed to 3 ppm of 2,4,5-T at 30C. Oxygen consumption in control and treatment groups did not differ at lower temperatures or for 2,4-D exposure. Mortality, pupation, and emergence were examined for *Chironomus* sp. exposed to 1 or 3 ppm of 2,4-D or 2,4,5-T. Significantly greater mortality and lower percentage pupation were observed in groups exposed to 3 ppm, 2,4,5-T at 30C.
W79-05830

WATER QUALITY: STREAMS AND PONDS ON SELECTED TEST AREAS ON EGLIN AIR FORCE BASE, FLORIDA,

Air Force Armament Lab., Eglin AFB, FL.
R. C. Crews, G. G. Wyman, S. M. Lefstad, and C. I. Miller.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A049 155. Price codes: A03 in paper copy, A01 in microfiche. Report AFATL-TR-77-72, May 1977. 32 p, 9 fig, 3 ref, 1 append.

Descriptor studies, *Ponds, H. Phosphates oxygen, H. *Eglin Air

Baseline for stream, Eglin Air water temp seasonal r oxygen (D water temp was 7.6 p trends. Al playing n chemical o turbidity, seasonal h The water good. It w 0.30 mg/l 9.5C to 31. and relativ ring consti W79-05835

THE PRE CARBONS DIATOM SLIMES, Bristol Un S. Thomp Estuarine i l, p 75-86

Descriptor facts, *Est sediments, nental Estuary(U

Preliminary population sediment (and an app hydrocarbo hydrocarbo bons (PAH of an inter lized by in computeri spectromet compared and the se phatic hyp slime appe separated The distrib bon in the that of th quantity of diatom slim have been the under) bons of the low carbon major com spectral 3,6,9,12,13, cyclic aro separated polycyclic aleased sec be explain bolic proc W79-05884

SIMULAT POPULAT SUMPTIO BATION, Oregon Str J. A. Wienn Fieber. In: Envir timental Sh gators for

Effects Of Pollution—Group 5C

Descriptors: *Water quality, *Florida, *Baseline studies, *Chemical oxygen demand, Streams, Ponds, Hardness(Water), Turbidity, Calcium, Phosphates, Nitrates, Temperature, Dissolved oxygen, Hydrogen ion concentration, Monitoring, *Eglin Air Force Base(FL).

Baseline information on water quality was derived for streams and ponds draining or located on the Eglin Air Force Base Reservation, Florida. The water temperature displayed seasonal trends (mean seasonal range 15.5C to 22.9C). The dissolved oxygen (DO) values were inversely related to the water temperature. The mean seasonal DO range was 7.6 ppm to 9.0 ppm. The mean seasonal pH was low, range 5.6 to 5.7, displaying no seasonal trends. Also remaining consistently low and displaying no seasonal trends were the calcium, chemical oxygen demand (COD), phosphates, and turbidity. The water was very soft, with a mean seasonal hardness range of 3.3 mg/l to 4.4 mg/l. The water quality at the 10 selected test areas was good. It was typified by an acid pH, hardness of 0.30 mg/l to 5.69 mg/l, a temperature range of 9.5C to 31.0C, a DO range of 3.8 ppm to 11.1 ppm, and relatively low levels of other naturally occurring constituents. (Visocky-LSWS)

W79-05839

THE PRESENCE OF POLLUTANT HYDROCARBONS IN ESTUARINE EPIPELIC DIATOM POPULATIONS. II. DIATOM SLIMES,

Bristol Univ. (England). School of Chemistry. S. Thompson, and G. Eglington. Estuarine and Coastal Marine Science, Vol 8, No. 1, p 75-86, January 1979. 3 fig, 2 tab, 34 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Estuaries, *Diatoms, *Sediments, Bottom sediments, Environmental effects, *Outer Continental Shelf, *Hydrocarbons, Severn Estuary(U.K.).

Preliminary studies of estuarine epipellic diatom populations showed a selective incorporation of sediment (crude oil-type) aliphatic hydrocarbons, and an apparent exclusion of polycyclic aromatic hydrocarbons. In the present study the aliphatic hydrocarbons and polycyclic aromatic hydrocarbons (PAH) of the diatom slime from the surface of an intertidal estuarine sediment have been analysed by improved analytical techniques including computerized capillary gas chromatography/mass spectrometry, and their distributions have been compared with those of the underlying sediment and the sediment-free diatom population. The aliphatic hydrocarbon distribution of the diatom slime appeared to be the sum of those of the separated diatoms and the underlying sediment. The distribution of polycyclic aromatic hydrocarbon in the diatom slime was qualitatively similar to that of the underlying sediment. However, the quantity of polycyclic aromatic hydrocarbon in the diatom slime was around 9 times less than would have been expected for the sum of the diatoms and the underlying sediment. The aliphatic hydrocarbons of the separated diatoms showed a relatively low carbon number distribution. The presence of a major component with the g.c. retention, and mass spectral features of all-cis-heneicosahexa 3,6,9,12,15,18-ene is reported. Only traces of polycyclic aromatic hydrocarbons were detected in the separated diatoms. The results suggest a loss of polycyclic aromatic hydrocarbons from the coalesced sediment in the diatom slime, which may be explained by either a photo-oxidative or catalytic process. (See also W79-02998) (Sinha-OEIS)

W79-05884

SIMULATION MODELING OF MARINE BIRD POPULATION ENERGETICS, FOOD CONSUMPTION, AND SENSITIVITY TO PERTURBATION,

Oregon State Univ., Corvallis. J. A. Wiens, G. Ford, D. Heinemann, and C. Fieber.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. II,

Receptors—Birds, p 1-83, October 1978. 16 fig, 55 tab, 14 ref, append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Birds, *Energy, *Alaska, Baseline studies, Resources development, Water pollution effects, Environmental effects, Oil pollution, Hazards, *Outer Continental Shelf, Bering Sea, Pribilof Islands, Petroleum development.

The approach and results of initial applications of computer simulation modeling of avian population energetics to Alaskan OCS marine bird systems are presented. The report considers estimations of energy demands of marine birds as recorded at sea during transect censuses in the Gulf of Alaska/southeast Bering Sea and in the vicinity of the Pribilof Islands; more intensive analyses of breeding colonies will occupy the next phase of the project. Total energy flow through pelagic bird populations in the Gulf of Alaska was greatest in the Kodiak area during August-September, but varied both between areas and with season, primarily as a consequence of movements of species populations associated with reproductive status. Activities related to petroleum development in these areas may be especially hazardous to bird populations. (Sinha-OEIS)

W79-05885

SHOREBIRD DEPENDENCE ON ARCTIC LITTORAL HABITATS,

California Univ., Bodega Bay. Bodega Marine Lab.

P. G. Connors.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol II, Receptors—Birds, p 84-166, October 1978. 16 tab, 18 ref, 7 append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-84.

Descriptors: *Birds, *Oil spills, *Water pollution effects, *Habitats, Ecology, Resources development, Alaska, Baseline studies, *Outer Continental Shelf, Shorebirds.

Shorebirds (sandpipers, plovers, and their relatives) are a major and important component of the Alaskan arctic avifauna. Seasonal, and occasionally very heavy, use of littoral (shoreline) habitats by shorebirds and other birds in the Arctic have been documented. The ultimate objective is the assessment of the degree and nature of dependence of shorebird species on arctic habitats which are potentially susceptible to perturbation from offshore oil development activities. Within this objective, critical habitats, critical trophic processes, and critical areas of the Beaufort and Chukchi coasts are identified and the relative susceptibilities of each shorebird species to potential disturbances are estimated. The implications for OCS oil development are clear. Leasing and development should be planned to minimize the threat to the most heavily used and most sensitive areas and habitats, and to avoid disturbances during periods of highest potential impact on bird populations. The effect of any oil spill could be quite serious depending upon timing as well as magnitude of the spill and upon the dispersal behavior of the oil under varying conditions of ice coverage. (Sinha-OEIS)

W79-05886

THE DISTRIBUTION, ABUNDANCE AND FEEDING ECOLOGY OF BIRDS ASSOCIATED WITH PACK ICE,

Point Reyes Bird Observatory, Stinson Beach, CA. G. J. Divoky, R. Boekelheide, E. Good, K. Hirsch, and H. Huber.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol II, Receptors—Birds, p 167-509, October 1978. 235 fig, 15 tab, 18 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 02-7-022-35410.

Descriptors: *Birds, *Ecology, *Abundance, *Ice, Oil pollution, Water pollution effects, Resources development, Environmental effects, Baseline studies, Alaska, *Outer Continental Shelf, *Pack ice, *Critical habitats, Bering Sea, Beaufort Sea, Petroleum development, Seabirds.

As part of an environmental assessment of the outer continental shelf of Alaska the distribution, abundance and feeding ecology of seabirds associated with pack ice are being studied. Birds in the Bering Sea are feeding primarily on fish and zooplankton associated with a deep warm water layer. The presence of deep warm water may be important in determining which areas are important to large numbers of birds. In the Beaufort shoreline migrants are feeding primarily on zooplankton while pelagic species are feeding on fish. For purposes of oil development all areas within 20 km of shore in the Beaufort can be considered critical habitat. The ice environment of the Bering, Chukchi and Beaufort seas will present problems unique to the exploitation of oil and gas reserves under these waters. Technical means have not been developed to keep moving pack ice from affecting oil platforms. Underwater pipelines transporting oil to the mainland will be in danger of rupture by keels on ice floes. For these and a number of other reasons, the occurrence of an oil spill or similar major disturbance is more likely in the pack ice than in ice-free waters. (Sinha-OEIS)

W79-05887

ECOLOGICAL STUDIES IN THE NORTHERN BERING SEA: BIRDS OF COASTAL HABITATS ON THE SOUTH SHORE OF SEWARD PENINSULA, ALASKA,

College of the Atlantic, Bar Harbor, ME.

W. H. Drury, J. O. Biderman, J. B. French, Jr., and S. Hinckley.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol II, Receptors—Birds, p 510-613, October 1978. 22 fig, 22 tab. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-6-022-35208.

Descriptors: *Birds, *Ecology, *Habitats, *Biology, Alaska, Oil pollution, Water pollution effects, Baseline studies, Environmental effects, Resources development, *Outer Continental Shelf, Bering Sea, Seward Peninsula, Wildfowl, Food supply, Petroleum development.

Those aspects of the biology of wildfowl which deserve careful consideration in order to avoid unnecessary damage in the course of development associated with the extraction of oil are identified. The objectives are to locate major concentrations of seabirds, waterfowl and shorebirds in space and time; to establish the numbers involved and the circumstances under which the gathering areas are important; to learn the relation of selected species of seabirds to the oceanic ecosystems by measuring the birds' reproductive rates and food dependencies; and to investigate the relation of biologically important areas to the geography and ecology of the Northern Bering Sea, such as location of nesting cliffs, feeding grounds at sea, and tundra nesting habitats, as well as those wetlands and mudflats which are used for feeding and escape from hunting pressure. The studies indicate that both Black-legged Kittiwakes and Common Murres are sensitive to changes in the food supply available in Norton Sound. Thus they offer the possibility of acting as indicator species for negative changes in the trophic structure of the sea. Studies also suggest that Ravens and Glaucous Gulls may act as indicator species, but of a different sort. These two species seem to benefit from organic wastes supplied by humans and thus to benefit from development. The contrast in the effects of development offered by these two pairs of species indicates that it may be dangerous to assign a priori, definite boundaries to the relation between a given species and what we consider to be its habitat or ecosystem. (Sinha-OEIS)

W79-05888

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

DISTRIBUTION AND ABUNDANCE OF MARINE BIRDS - SOUTH AND EAST KODIAK ISLAND WATERS,

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. C. J. Lesinski, P. J. Gould, C. S. Harrison, and D. Forsell.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol II, Receptors—Birds, p 614-710, October 1978. 29 fig, 28 tab, 41 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Birds, *Abundance, *Habitats, *Temporal distribution, *Spatial distribution, Alaska, Water pollution effects, Baseline studies, Oil spills, Environmental effects, Resources development, *Outer Continental Shelf, *Ecological distribution, Food supply, Kodiak Basin, Petroleum development.

This project is designed to provide information on the seasonal distribution and abundance of birds in Alaska's marine habitats. The most important factors influencing marine bird distribution and density appear to be: (1) location of suitable breeding areas, (2) physical characteristics of the surface water (salinity, tide rips, etc.), (3) availability of suitable food, (4) bottom topography, (5) reproductive status of the birds, and (6) location of extensive fishing and fish processing operations. Data on distribution and abundance of marine birds indicates that vast numbers of birds are 'at risk' to pollution of Alaska's marine habitats. The kinds and numbers of birds involved will vary greatly in time and space but high impact levels, at least on a short-term basis, are inevitable. Each bird species will have a varying and unique degree of vulnerability to pollution (e.g., oil spills) depending on, in part, the following factors: (1) species spending more time in the water than in the air are the most vulnerable, (2) species forming large dense flocks are more vulnerable than less gregarious species, (3) species breeding in the area are more vulnerable than nonbreeding species because productivity is affected, (4) some species are rarer than others and thus are more vulnerable because of the reduced possibility of rebuilding populations by immigration from other areas, (5) year-round residents are more vulnerable to local pollution problems than seasonal residents and migrants, (6) species preferring areas of entrained water are more vulnerable than species which prefer areas of strong currents, and (7) species going through a flightless period at-sea (e.g., heavy molt or precocial young) are more vulnerable than species capable of year-round flight. (Sinha-OEIS)

W79-05889

AVIAN COMMUNITY ECOLOGY AT TWO SITES ON ESPENBERG PENINSULA IN KOTZEBUE SOUND, ALASKA,

Alaska Univ., Fairbanks. Inst. of Arctic Biology. P. G. Mickelson, D. Shamel, and D. Tracy.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol II, Receptors—Birds, p 711-750, October 1978. 7 tab, 2 ref, 21 charts. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-56.

Descriptors: *Birds, *Ecology, *Phenology, *Data, Alaska, Environmental effects, Baseline studies, Resources development, Water pollution effects, *Outer Continental Shelf, Kotzebue Sound, Ecological distribution, Petroleum development, Cape Espenberg(AK).

The objective of this project were: to determine phenology of events from spring arrival through departure of birds; to determine the distribution and abundance of birds and their predators; to describe habitat utilization of birds and their predators during migration, the nesting season, and the brood rearing season; to estimate production of all avian species nesting on Cape Espenberg; to determine the abundance of small mammals which are utilized by avian and mammalian predators; to

describe availability of food and utilization by shorebirds; to determine distribution and abundance of sea mammals; to provide recommendations to lessen the impact of developments on the avian community and avian habitat at Cape Espenberg; to establish baseline study plots to evaluate the impact of developments on the avian community and avian habitat at Cape Espenberg; and to assess bird use of coastal habitats in southern Kotzebue Sound by flying aerial surveys at regular intervals. In this brief report only those data products included are: small mammal abundance, bird measurements, birds banded, and daily bird observations. (Sinha-OEIS)

W79-05890

ECOLOGICAL STUDIES IN THE NORTHERN BERING SEA: STUDIES OF SEABIRDS IN THE BERING STRAIT.

College of the Atlantic, Bar Harbor, ME. W. H. Drury, and J. O. Biderman.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol II, Receptors—Birds, p 751-838, October 1978. 16 fig, 13 tab. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-6-022-35208.

Descriptors: *Birds, *Ecology, *Baseline studies, *Alaska, Aircraft, Water pollution effects, Resources development, Environmental effects, Reproduction, *Outer Continental Shelf, Bering Strait, Seabirds, Food supply, Petroleum transport, Ecological distribution.

In the area between Cape Lisburne and Saint Lawrence Island there are 3,725,000 to 4,000,000 seabirds. Little Diomed Island, the subject of this study, is a major seabird colony and the northernmost nesting colony of Parakeet, Crested and Least Auklets. Drastic population reduction or steady declines are possible results of development. It has been suggested that populations be reduced at experimental colonies in order to establish the rate of recovery. Although the evidence is not clear, there is a suggestion that numbers of murres at Little Diomed Island have decreased since the late 1950s. If real, a decrease is consistent with the decrease of murres observed during the same period at Cape Thompson. Similarly, there is evidence that the numbers of Crested Auklets have decreased, which would be consistent with the reports to that effect by Orville Ahkinga and John Ayapana of Igloodok. It is generally believed that Arctic birds are subjected to stress by the extra effort required for breeding. Any further stress introduced by the impacts of development upon their food sources are likely to cause some degree of reproductive failure. An important aspect of OCSEAP is defining differences in biological oceanographic structures of the Bering Sea. Disturbance by the chronic effects of through traffic, by secondary effects such as helicopter operations and coastal development, by direct damage from oil spills or by indirect effects on the food of the seabirds will affect an area that is comparable to the plains of East Africa among the major natural wonders of the world. (Sinha-OEIS)

W79-05891

ECOLOGICAL STUDIES OF COLONIAL SEABIRDS AT CAPE THOMPSON AND CAPE LISBURN, ALASKA,

Renewable Resources Consulting Services, Ltd. Fairbanks, AK.

A. M. Springer, and D. G. Roseneau. In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol II, Receptors—Birds, p 839-960, October 1978. 28 fig, 50 tab, 16 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-6-022-35210.

Descriptors: *Birds, *Ecology, *Water pollution effects, *Environmental effects, Oil spills, Resources development, Exploration, Alaska, *Outer Continental Shelf, Chukchi Sea, Seabirds, Petro-

leum development, Terminal facilities, Ecological distribution, Food supply, Foraging.

The colonies at Cape Thompson and Cape Lisburne support most of the breeding seabirds in the eastern Chukchi Sea. The birds constitute a major component of the ecosystem in this region. Perturbations of the environment by resource development in the Hope Basin could threaten the health and stability of these seabird populations. The birds nesting at Cape Thompson, Cape Lisburne and Cape Lewis could be threatened by OCS development in several ways. Spills south or west of Cape Thompson, Cape Lisburne and Cape Lewis would be driven closer to these colonies or onto their beaches by prevailing southerly and westerly winds. High velocity northerly winds, also prevalent in the area, could, on the other hand, prevent oil from reaching the colonies themselves if all conditions were right. Because of the currents and wind patterns in the region, however, floating oil will almost certainly impinge upon foraging areas whether or not it actually reaches the coastline. At Cape Thompson floating oil originating from spills in the northern Bering Strait or southern Chukchi Sea may offer the greatest potential danger to the colony. The Cape Thompson colonies also are located at a point potentially attractive for use during exploration activities, and more importantly, for construction of a major marine terminal. Increased human activity could cause a variety of disturbances that may adversely influence the reproductive success of several species. (Sinha-OEIS)

W79-05892

POPULATION DYNAMICS AND TROPHIC RELATIONSHIPS OF MARINE BIRDS IN THE GULF OF ALASKA AND SOUTHERN BERING SEA,

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. S. A. Hatch, D. R. Nysewander, A. R. DeGange, M. R. Petersen, and P. A. Baird.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol III, Receptors—Birds, p 1-68, October 1978. 13 fig, 14 tab. NOAA, Outer Continental Shelf Environmental Assessment Program. 01-5-022-2538.

Descriptors: *Birds, *Oil spills, *Water pollution effects, *Environmental effects, Baseline studies, Habitats, Resources development, *Outer Continental Shelf, Gulf of Alaska, Bering Sea, Ecological distribution, Foraging areas.

Site-specific studies of marine birds were conducted at 8 locations in the Gulf of Alaska and southern Bering Sea during the 1977 field season. Studies at 6 locations focused on traditional 'seabirds' while two studies focused primarily on shorebirds and waterfowl. The most visible of potential impacts on birds from OCS development will be the death and littering of beaches with carcasses of oiled birds as a result of catastrophic oil spillage from platforms, pipelines, terminal and storage facilities and tankers. A second category of direct impacts may result from human disturbances associated with human occupation and of transportation and construction activities near nesting habitats or foraging areas. Because of the large populations of birds in water adjacent to Alaska, which exceed the total of birds in the remainder of the northern hemisphere, losses resulting from an oil spill off the coast of Alaska may be much larger than ever before experienced. Indirect impacts such as occur through contamination or reduction of food resources, causing lower survival or reproductive rates may, however, be even more important, as such changes may result in long term reduction in populations or preclude recovery of populations subjected to losses from oil spills. (Sinha-OEIS)

W79-05893

AVIFAUNAL ASSESSMENT OF NELSON LAGOON, PORT MOLLER, AND HEREN-DEEN BAY, ALASKA - 1977,

Fish and Wildlife Service, Anchorage, AK. Office

of Biological R. Gill, M. F. DeGange.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol III, Receptors—Birds, p 11 ref, 3 a. Environmental Assessment Program, Boulder, Colorado. 01-

Descriptors: tions, effects, Resou, Shelf, Deepen, dition dynam, Alaska, Bering

This report dynamics and in the Gulf The Nelson ine area along a diverse av Alaska Peninsula Peninsula te dismissed, its staging area tending birds. lagoons far adjacent Bering vegetation a create an ide wintering bi needed to su processes and the estuarine changes in a greater conc grounds. Be tremely vuln shore and o components in su equal threat relatively dec ed developm greater poten than those a and spills. (S W79-05894

BREEDING OF FULMAR WITH OBSERVATION OF SY,

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. S. A. Hatch.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol III, Receptors—Birds, p 11 ref, 3 a. Environmental Assessment Program, Boulder, Colorado. 01-

Descriptors: tions, effects, Resou, Shelf, Deepen, dition dynam, Alaska, Bering

A population occupy over 6 during the b spanned the p from 20 July began about Fulmars depa ber. Nesting p year than in 1 or 386 breed three-fold inc season. Associi success v zodus, shorte tion of molt suggests great appears to be

Effects Of Pollution—Group 5C

of Biological Services and Coastal Ecosystems. R. Gill, M. Petersen, C. Handel, J. Nelson, and A. DeGange.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol III, Receptors—Birds, p 69-131, October 1978. 14 fig, 11 ref, 3 append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Oil pollution, *Water pollution effects, Alaska, Minerals, Environmental effects, Resources development, *Outer Continental Shelf, Deepwater ports, Germinal facilities, Population dynamics, Trophic relationships, Gulf of Alaska, Bering Sea, Nelson Lagoon complex.

This report is part of a study of the population dynamics and trophic relationships of marine birds in the Gulf of Alaska and southern Bering Sea. The Nelson Lagoon complex is the largest estuarine area along the Bristol Bay shoreline. It supports a diverse avifauna found nowhere else along the Alaska Peninsula. While the value of the Alaska Peninsula terrace as a breeding area can not be dismissed, its overwhelming importance is that of a staging area for migratory, post-breeding and wintering birds. The productivity of many of these lagoons far exceeds that of equivalent areas of the adjacent Bering Sea. The vast meadows of aquatic vegetation and super abundant benthic faunas create an ideal situation for migratory, molting and wintering birds to obtain the energy reserves needed to sustain them through these demanding processes and periods. The physiographic nature of the estuarine areas, coupled with post-breeding changes in social structure, force birds into much greater concentrations than found on the breeding grounds. Because of this, the birds become extremely vulnerable to oil contamination from offshore and onshore spills. Similarly, onshore developments in support of mineral exploitation pose an equal threat and should be strictly regulated. The relatively deepwater port capabilities and associated developments of Port Moller have, equal or greater potential impact to waterbird populations than those associated with offshore development and spills. (Sinha-OEIS) W79-05894

BREEDING AND POPULATION ECOLOGY OF FULMARS AT SEMIDI ISLANDS, ALASKA, WITH OBSERVATIONS ON THE REPRODUCTION OF SYMPATRIC SEABIRD SPECIES. Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. S. Hatch.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol III, Receptors—Birds, p 132-207, October 1978. 29 fig, 13 tab, 11 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Breeding, *Phenology, *Reproduction, Ecology, Baseline studies, Environmental effects, Water resources, Water pollution effects, Resources development, Alaska, *Outer Continental Shelf, *Food supply, Population structure, Ecological distribution, Gulf of Alaska, Semidi Islands.

A population of some 475,000 Northern Fulmars occupy over 40 miles of coastline at Semidi Islands during the breeding season. In 1977 egg-laying spanned the period 2-21 June, hatching occurred from 20 July - 8 August and fledging probably began about 10 September with the last young Fulmars departing during the first week in October. Nesting phenology was four days later in this year than in 1976. Reproductive success was 51% for 386 breeding pairs, representing more than a three-fold increase over production in the 1976 season. Associated with the higher level of breeding success were a less pronounced pre-laying exodus, shorter incubation shifts and earlier initiation of molt in unemployed birds, each of which suggests greater food availability in 1977. There appears to be a critical period around the time of

egg-laying when food supply and the nutritional status of breeding birds largely determines the outcome of the season's nesting effort. Information on the foraging range and feeding areas of Fulmars breeding at Semidi Islands is needed, and could best be obtained through coordinated onshore and aerial observations. An open nesting habit, high degree of fidelity to nest-site and mate and individual variation in body color render the Fulmar at Semidi Islands uniquely suited to a study of the dynamics of population structure and productivity. Observations on phenology and production in other seabirds breeding at Semidi Islands indicated that, for most species, the timing of breeding was very similar while reproductive success was higher in 1977 compared to the previous year. The dynamics of nest-site ownership and breeding status may be very relevant from the standpoint of predicting population responses of Fulmars to environmental disturbance. (Sinha-OEIS) W79-05895

STUDIES OF MARINE BIRDS ON UGAISHAK ISLAND, SHAK ISLAND,

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. D. H. S. Wehle.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol III, Receptors—Birds, p 208-312, October 1978. 42 fig, 25 tab, 2 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Ecology, *Environmental effects, Oil pollution, Water pollution effects, Resources development, Baseline studies, Alaska, *Outer Continental Shelf, *Population structure, *Ecological distribution, Seabird colonies, Food supply, Petroleum development, Gulf of Alaska, Ugaiushak Island.

The Ugaiushak Island seabird colony is a part of a large complex of colonies included in the proposed Shumagin Islands National Wildlife Refuge. Birds from these colonies would be vulnerable to any extensive pollution by oil in the Western Gulf of Alaska such as may occur with the development of petroleum in Kodiak Basin. This study of populations and ecology of the marine avifauna of Ugaiushak Island continues studies conducted on this island in 1974 and 1976. A great deal of variation was observed between 1976 and 1977 in several aspects of the reproductive ecology of most seabird species studied. Although the reasons for the variation observed are unknown, it is believed that availability of food resources is probably the most important single factor. (Sinha-OEIS) W79-05896

THE BREEDING BIOLOGY AND FEEDING ECOLOGY OF MARINE BIRDS IN THE SITKALIDAK STRAIT AREA, KODIAK ISLAND, 1977,

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. P. A. Baird, and R. A. Moe.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol III, Receptors—Birds, p 313-324, October 1978. 86 fig, 77 tab, 16 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Breeding, *Ecology, *Environmental effects, *Oil spills, Alaska, Resources development, Baseline studies, Water pollution effects, *Outer Continental Shelf, *Food supply, Feeding, Kodiak Island.

The purpose of the study at Sitkalidak Strait, Kodiak Island, Alaska was to collect information on the breeding biology and feeding ecology of five major species of birds: Black-legged Kittiwakes, Tufted Puffins, Arctic and Aleutian Terns, and Glaucous-winged Gulls. This information is necessary in order to assess the pre-drilling avian ecology at Sitkalidak. Areas of the Outer

Continental Shelf nearby are soon to be drilled and until this study, there had been no ecological assessment of the avifauna in the area. The most obvious danger of offshore oil development in the Kodiak waters are oil spills. The vulnerability of seabirds to such spills has been well documented. One effect of oil spills in the marine environment is a decrease in the available food supply because of the depth or contamination of prey species which have succumbed to or have accumulated the toxic fractions of oil. Another is the buildup of toxic hydrocarbons in the birds themselves as a result of the ingestion of contaminated prey. Any oil slicks in the Sitkalidak Strait area during May through September could also have a direct effect on the seabirds by oiling any birds rafting off the colonies or feeding in the strait. Convergence lines and tide rips were found to be important feeding areas for all species, and it is here that much of the oil would accumulate, presenting a serious threat. Onshore development and shipping activities also should not be close enough to existing colonies to cause abnormal disturbances to the nesting birds. (Sinha-OEIS) W79-05897

THE BREEDING BIOLOGY OF MARINE BIRDS ASSOCIATED WITH CHINIYAK BAY, KODIAK ISLAND, 1977,

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. D. Nysewander, and E. Hoberg.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol III, Receptors—Birds, p 525-574, October 1978. 9 fig, 17 tab, 27 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Biology, *Breeding, *Food chains, *Baseline studies, *Ecology, Alaska, Oil spills, Water pollution effects, Resources development, Environmental effects, *Outer Continental Shelf, Kodiak Island, Petroleum transport, Ecological distribution.

Lease sales are imminent for many portions of the continental shelf areas surrounding Kodiak Island. The town of Kodiak and parts of Chiniyak Bay are slated to be staging and resupply areas. Two Kodiak oil spills in January and March 1970 have already indicated what adverse impacts offshore shipping can have: at least 10,000 birds died with the possibility of 100,000 birds having been killed. If marine birds are valid indication of the health of the food chain and there is increasing evidence to support this concept, then it is essential to continue expanding baseline data and monitoring studies of the marine birds in the region. Chiniyak Bay offers some unique opportunities to develop some baseline data on breeding biologies of marine birds that have no published data on them. The lack of predators makes feasible the study of both the Pelagic and Red-faced Cormorants. The presence of Aleutian Tern colonies and an unusual Mew Gull colony afford similar opportunities. One of the critical times for marine birds in Chiniyak Bay is the winter when numerous waterfowl and alclids frequent the bay. (Sinha-OEIS) W79-05898

DYNAMICS OF MARINE BIRD POPULATIONS ON THE BARREN ISLANDS, ALASKA,

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. D. A. Manuwal, and D. Boersma.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol III, Receptors—Birds, p 575-679, October 1978. 29 fig, 35 tab, 146 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Baseline studies, *Oil pollution, Alaska, Water pollution effects, Food chains, Currents, Environmental effects, Resources development, *Outer Continental Shelf, Barren Islands, Petroleum transport.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

The Barren Islands project was designed to gather baseline information on seabirds which would be useful in determining the human use and management requirements necessary for maintaining the present seabird population. The Barren Islands with their sizable seabird and marine mammal populations could sustain severe damage from oil because of its current regime. Tidal variation is great and fishermen regard the islands as some of the more hazardous fishing areas because of the strong tidal currents and frequent storms. Oil coming to the islands is likely to be widely dispersed. Because of the currents and winds, cleanup equipment can generally be considered useless in the Barren Islands. The rocky beaches and kelp beds characteristic of the islands also make them particularly sensitive to oil. These areas act as traps where toxicities build up but are not easily flushed. To make matters worse, the least damaging mechanical cleanup method is impossible to use in these areas. The extent of damage on the habitat or physiography of an area will depend on the oil type, oil dosage, oceanographic conditions, meteorological conditions and turbidity. (Sinha-OEIS) W79-05899

COMMUNITY STRUCTURE OF SEABIRDS OF WOODED ISLAND, ALASKA.

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. P. G. Mickelson, W. Lehnhansen, and S. E. Quinlan.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. III, Receptors—Birds, p 680-772, October 1978. 11 fig, 20 tab, 37 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Oil pollution, *Baseline studies, *Water pollution effects, Alaska, Ecosystems, Environmental effects, Oil spills, *Outer Continental Shelf, Gulf of Alaska, Petroleum transport, Wooded Islands.

Information was obtained about the breeding distribution, abundance, phenology, and productivity of seabirds using Wooded Island in the Gulf of Alaska. Major seabird species on Wooded Islands, and those discussed in this report are: Tufted Puffins, Fork-tailed Storm Petrels, Black-legged Kittiwakes, Leach's Storm Petrels, Glaucous-winged Gulls, Cormorants (Double-crested, Pelagic, and Red-faced), Pigeon Guillemots, Common Murres, Parakeet Auklets, and Horned Puffins. Wooded Islands may become an attraction to tourists and residents of Alaska because of their accessible location and the variety of breeding seabirds and marine mammals they harbor. Wooded Islands and the surrounding waters are threatened with oil pollution in the near future. Outer Continental Shelf oil and gas exploration has already begun in the northern Gulf of Alaska. Oil tankers are carrying crude oil south by Wooded Islands from the Valdez terminal of the Trans-Alaska oil pipeline. The effects of oil spills on Wooded Islands seabirds and other birds using the area depends largely upon the amount of oil spilled, the time of year of the spill, the stage of tides, wind velocity when oil reaches Wooded Islands area, and the success of clean-up measures. In summary, oil spills can produce a variety of direct and indirect effects which reduce the survival of birds. All possible caution should be used to minimize the probability of a large oil spill. Chronic low level oil pollution especially should be minimized. It is potentially more dangerous to the ecosystem than catastrophic spills since food organisms may concentrate hydrocarbons and remain contaminated for several years. (Sinha-OEIS) W79-05900

THE FEEDING ECOLOGY AND TROPHIC RELATIONSHIPS OF KEY SPECIES OF MARINE BIRDS IN THE KODIAK ISLAND AREA, MAY-SEPTEMBER 1977.

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. G. Sanger, V. F. Hironaka, and A. K. Fukuyama.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. III, Receptors—Birds, p 773-848, October 1978. 46 fig, 7 tab, 20 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Ecology, *Ecosystems, *Food chains, *Baseline studies, Alaska, Water pollution effects, Environmental effects, Resources development, *Outer Continental Shelf, *Feeding habits, *Trophic relationships, Ecological distribution, Kodiak Island.

This study was conducted in the general area off northeastern Kodiak Island, from Marmot Bay south to the Geese Islands, and over the shelf to about 45 km offshore of the major headlands. Bird collections for feeding habits studies were concentrated in and offshore from Marmot and Chiniak Bays in the north, and in the area around Sitkalidak Island in the south. A total of 428 specimens of the five key species was collected in this study. These are summarized by species, cruise period and general area of collection. The possibility of the kind of prey influencing the physiological condition of birds, such as suggested by the amount of euphausiids in the diet of Short-tailed Shearwaters influencing their fat index, suggests that an understanding of the biomass of prey consumed only tells part of the story of trophic relationships. The energy value of different prey, as well as their assimilation rates in the birds, will have to be understood before trophic relationships can be understood beyond the preliminary level presented here. (Sinha-OEIS) W79-05901

CATALOG OF ALASKAN SEABIRD COLONIES.

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. A. Sowls.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. III, Receptors—Birds, p 849-856, October 1978. 6 fig, NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Alaska, *Ecosystems, *Data collections, Baseline studies, Resources development, Environmental effects, Water pollution effects, *Outer Continental Shelf, *Catalogs, Seabird colonies.

The objective of the colony catalog is to provide information on location, species composition and populations for Alaskan seabird colonies. Data are organized for quick access at whatever level is needed for management and scientific queries. The system includes a file containing the original data, references and maps, and photographs when they are available. This file is located in the Anchorage office of the U.S. Fish and Wildlife Service, Office of Biological Services - Coastal Ecosystems. A computer format was devised for colony catalog data but has not yet been digitized. This report presents an update on the preparation of the final catalog, a statewide summary of three seabird species and recommendations for further study. (Sinha-OEIS) W79-05902

SURVEY OF BEACHED MARINE BIRDS IN ALASKA.

Fish and Wildlife Service, Anchorage, AK. Office of Biological Services and Coastal Ecosystems. K. D. Wohl.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. III, Receptors—Birds, p 857-876, October 1978. 1 fig, 4 tab, 52 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-033-2538.

Descriptors: *Birds, *Mortality, Surveys, *Baseline studies, *Alaska, Water pollution effects, Environmental effects, Resources development, *Outer Continental Shelf, *Beached birds, Gulf of Alaska.

There are no direct means for measuring mortality of marine birds except during the short period they are congregated on their breeding sites. Major sources of mortality are a matter of conjecture and many incidents of mass mortality likely go undetected. However, since carcasses of birds and mammals float and are relatively durable, they are frequently washed ashore following their death at sea. It follows that their appearance on coastal beaches provides an indication of the temporal, and geographic patterns of normal mortality as well as evidence of the character of hazards affecting the survival of these animals. One of the objectives of the beached marine bird and mammal survey program are to establish a temporal, spatial, and frequency index of normal mortality as evidenced by observing dead birds and mammals on selected beaches in the northern Gulf of Alaska. Surveys of beached marine birds and mammals are conducted on as regular a basis as weather will permit at 15 locations in the northern Gulf of Alaska - four in Lower Cook Inlet, four in Northeastern Gulf of Alaska and seven in northwest Gulf of Alaska (Kodiak Island). In addition to the 15 year-round survey transects, there are 34 other locations, comprising about 84 km in the northern Gulf and Bering Sea regions, where surveys have been conducted on an opportunistic basis since 1974. (Sinha-OEIS) W79-05903

NUTRITIONAL SIGNIFICANCE OF COPPER-BERING INTERTIDAL SYSTEM TO SPRING-MIGRATING SHOREBIRDS BREEDING IN WESTERN ALASKA.

Alaska Univ., Fairbanks. Inst. of Arctic Biology, S. E. Senner, and G. C. West.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. III, Receptors—Birds, p 877-908, October 1978. 9 fig, 4 tab, 21 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 01-5-022-2538.

Descriptors: *Birds, *Migrations, *Intertidal areas, *Baseline studies, *Habitats, Resources development, Water pollution effects, Environmental effects, Nutrition, Alaska, *Outer Continental Shelf, *Petroleum transport, *Habitat degradation.

In the year ending 1 April 1978, significant new dimensions were added to an appraisal of the Copper River Delta system as critical habitat for Dunlins and Western Sandpipers in spring migration. Both species appear to be highly susceptible to any intertidal habitat degradation in the C-BRD system, although of the two, the Dunlin shows a higher degree of obligate habitat dependency on the C-BRD system itself. By contrast, current understanding leads us to regard habitat degradation in Lower Cook Inlet as at least as serious a threat to westerns as similar events in the Copper-Bering system. Applications of the information obtained in this study will primarily be used in documenting or refuting the suggested importance of this unique heavily used geomorphic feature and habitat. The results may be useful in specifically indicating protective measures by state and federal resource management agencies. Several potentially damaging petroleum-related developments underway or proposed in the northern Gulf of Alaska make these objectives pertinent, such as marine tanker travel to and from Valdez daily. (Sinha-OEIS) W79-05904

SURVEY OF THE EPIFAUNAL INVERTEBRATES OF THE SOUTHEASTERN BERING SEA.

Alaska Univ., Fairbanks. Inst. of Marine Sciences. H. M. Feder, J. Hilsinger, M. Hoberg, S. Jewett, and J. Rose.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. IV

Effects Of Pollution—Group 5C

Receptors—Fish, Littoral, Benthos, p 1-126, October 1978. 17 fig, 30 tab, 92 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-56.

Descriptors: *Invertebrates, *Baseline studies, *Resources development, Environmental effects, Water pollution effects, Oil pollution, Alaska, *Outer Continental Shelf, *Ecological distribution, *Trophic relationships, Faunal composition, Faunal abundance, Epifaunal biomass, Bering Sea.

The 1975-76 trawl study considered in this report delineates the major epifaunal species on the eastern Bering Sea shelf in regions of offshore oil and gas concentrations. Data were obtained on faunal composition and abundance which now are baselines to which future changes can be compared. Long-term studies on life histories and trophic interactions should define functional aspects of communities and ecosystems that are vulnerable to environmental damage, and should help determine the rates at which damaged environments can recover. Initial assessment of all data suggests that: sufficient station uniqueness exists to permit development of monitoring programs based on species composition at selected stations utilizing trawl techniques, and adequate numbers of biologically well-known, unique, and/or large species are available to permit nomination of likely monitoring candidates once industrial activity is initiated. (Sinha-OEIS) W79-05905

THE DISTRIBUTION, ABUNDANCE, DIVERSITY AND PRODUCTIVITY OF THE WESTERN BEAUFORT SEA BENTHOS,

Oregon State Univ., Corvallis. School of Oceanography.

A. G. Carey, Jr.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. IV, Receptors—Fish, Littoral, Benthos, p 127-252, October 1978. 34 tab, 2 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-68.

Descriptors: *Benthos, *Ecology, *Temporal distribution, *Spatial distribution, *Baseline studies, Computer programs, Resources development, Water pollution effects, Environmental effects, Food chains, Alaska, *Outer Continental Shelf, Beaufort Sea, Petroleum development.

Extensive exploration and development for oil and gas on the Alaskan and Canadian continental shelf have the potential to significantly influence the marine environment of the Beaufort Sea. The past and continuing goal of this project has been to acquire the knowledge of the ecology of benthic invertebrate faunas of the Beaufort Sea continental shelf necessary to evaluate the consequences of offshore oil and gas development. The distribution and abundance of the fauna has been examined in detail with studies of the spatial and temporal variability of these. These data will provide a baseline against which future changes in the benthic environment and community structure can be evaluated. Of current importance are: (1) the determination of the life histories and secondary production estimates of dominant and ecologically important species, (2) the definition of temporal changes in sublittoral community structure, (3) the description of the benthic food web, and (4) the study of the ecology of benthic invertebrates important as prey organisms to the marine mammals, birds, and fishes. Now that broad ecological patterns of benthic invertebrates on the Beaufort Sea shelf are becoming fairly well known, it is imperative to define the dynamic processes maintaining temporal and spatial structure. Extensive exploratory and production drilling for petroleum has the potential to significantly influence the marine benthic environment and its associated biota. The timing of environmental disturbances in this strongly seasonal environment may be extremely critical in determining the stresses experienced by the benthic community. (Sinha-OEIS) W79-05906

BASILENE/RECONNAISSANCE CHARACTERIZATION LITTORAL BIOTA, GULF OF ALASKA AND BERING SEA,

National Marine Fisheries Service, Auke Bay, AK. Northwest and Alaska Fisheries Center.

C. E. O'Clair, J. L. Hanson, J. S. MacKinnon, J. A. Gharrett, and N. I. Calvin.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. IV, Receptors—Fish, Littoral, Benthos, p 256-415, October 1978. 80 fig, 6 tab, 59 ref, 3 append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Invertebrates, *Aquatic plants, *Baseline studies, *Intertidal areas, Alaska, Water pollution effects, Environmental effects, Oil pollution, Resources development, *Outer Continental Shelf, Gulf of Alaska, Bering Sea, Petroleum development, *Mytilus edulis*, *Fucus distichus*.

The distribution and relative abundance patterns of littoral plants and invertebrates at the eighteen representative sites in the eastern Gulf of Alaska are described. The role of an important interaction in intertidal communities, competition for space, especially competition among dominant competitors and accompanying effects on subdominants were examined. Data indicate that total species richness tends to be greater in patches of intertidal area dominated by *Mytilus edulis* than in patches dominated by *Fucus distichus*, and that the difference is accounted for by increased species richness of small subdominants in *Mytilus* dominated areas. *Mytilus* does not appear to have a greater adverse effect on competitively inferior large subdominants than does *Fucus*. Pollution by oil and oil dispersants has been shown to produce major changes in the abundances of algae and invertebrates indirectly by temporarily eliminating herbivores which ultimately can delay recolonization for up to 9-10 years. In these studies the most important effect of oil and oil dispersants was the temporary reduction of a key biological interaction, herbivory by limpets and urchins. (Sinha-OEIS) W79-05907

DISTRIBUTION, ABUNDANCE, COMMUNITY STRUCTURE, AND TROPHIC RELATIONSHIPS OF THE NEARSHORE BENTHOS OF THE KODIAK SHELF, COOK INLET, NORTH-EAST GULF OF ALASKA AND THE BERING SEA,

Alaska Univ., Fairbanks. Inst. of Marine Science. H. M. Feder, M. Hobert, A. J. Paul, J. McDonald, and G. Matheke.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. IV, Receptors—Fish, Littoral, Benthos, p 416-730, October 1978. 30 fig, 22 tab, 14 ref, 2 append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-56.

Descriptors: *Benthos, *Abundance, *Ecology, Alaska, Spatial distribution, Temporal distribution, Environmental effects, Water pollution effects, Resources development, *Outer Continental Shelf, *Ecological distribution, Trophic relationships, Community structure, Gulf of Alaska, Bering Sea, Kodiak Shelf, Cook Inlet.

The operations connected with oil exploration, production, and transportation in the Gulf of Alaska and the Bering Sea present a wide spectrum of potential dangers to the marine environment. Adverse effects on the marine environment of these areas cannot be quantitatively assessed, or even predicted, unless background data are recorded prior to industrial development. Initial assessment of all data suggests that: (1) sufficient station and/or area uniqueness exists to permit development of monitoring programs based on species composition at selected stations utilizing both grab and trawl sampling techniques, and (2) adequate numbers of biologically well-known, unique, abundant, and/or largespecies are available to permit nomination of likely monitoring candidates for the areas once industrial activity is initiated. Fifty-three permanent stations have been established in

two bays of Kodiak Island. Fifty-three permanent stations have been established in two bays of Kodiak Island. Sampling crabs and fishes using trawls and stomach analysis has made it possible to understand a major component (the epifauna) of two Kodiak bays. However, a full comprehension of the benthic systems there will only be achieved when these studies are expanded to include an assessment of infauna as well. Forty-two widely dispersed permanent stations have been established to sample the infauna in the northeastern Gulf of Alaska in conjunction with the physical, chemical, heavy metals and hydrocarbon programs. These stations represent a reasonable nucleus around which a monitoring program can be developed. Seventy-seven widely dispersed permanent stations and seven stations of opportunity have been established in conjunction with the chemical, hydrocarbon, heavy metals, and geological programs in the Bering Sea. (Sinha-OEIS) W79-05908

RECONNAISSANCE CHARACTERIZATION OF LITTORAL BIOTA, BEAUFORT AND CHUKCHI SEAS,

Western Washington Univ., Bellingham.

A. C. Broad, H. Koch, D. T. Mason, G. M. Petrie, and D. E. Schneider.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. V, Receptors—Fish, Littoral, Benthos, p 1-42, October 1978. 19 tab, 3 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-81.

Descriptors: *Aquatic life, *Aquatic plants, *Baseline studies, Environmental effects, Water pollution effects, Oil pollution, Resources development, Biota, Alaska, *Outer Continental Shelf, *Feeding grounds, Beaufort Sea, Chukchi Sea.

The fauna of the Beaufort littoral (2m depth to shoreline) region is poor in species and biomass and probably is depopulated annually by shore-fast ice. There are, however, resident populations of encyrtid (Oligochaete) worms and chironomid (midge) larvae that must, somehow, be frozen in during the winter. The former, although numerous, account for very little total biomass. Their ecological role is unknown. The latter are fed upon by important anadromous fishes. The Beaufort near-shore (+2m to 20m) is a refuge from which the littoral region is repopulated annually. The fauna of the nearshore region is intermediate in species diversity and biomass between the littoral and close offshore regions. The fauna of the Beaufort littoral/nearshore and the Chukchi littoral north of Point Hope are similar in species, diversity, and biomass. Plant communities of Arctic Alaskan beaches may be categorized in eight major types. The most common lower beach communities (mainly combinations of the grass, *Puccinellia phryganeoides* and sedges of the genus *Carex*) may be called salt marshes. These marshes are important feeding areas for geese, brant, shorebirds, and to some extent caribou. *Carex* species and other beach plants contribute significantly to soil stability and probably resist shoreline erosion. Oil in low quantities adversely affects in a single season the growth of *Carex* in salt marshes. Sand drift which may accompany beach erosion adversely affects growth of arctic salt marsh plants. (Sinha-OEIS) W79-05909

PLANT COMMUNITIES OF ALASKAN ARCTIC BEACHES,

Western Washington Univ., Bellingham.

R. J. Taylor.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. V, Receptors—Fish, Littoral, Benthos, p 43-60, October 1978. 4 fig, 9 tab. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-81.

Descriptors: *Aquatic plants, *Habitats, *Beaches, *Salt marshes, Baseline studies, Arctic Ocean, Alaska, Erosion, Environmental effects, Resources

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

development, Dunes, *Outer Continental Shelf, *Beaufort Sea, *Ecological distribution, Elymus mollis, Chukchi Sea.

Arctic Alaskan shorelines can be divided into six very general habitat-types. Plant communities of each of these habitat-types are rather consistent in occurrence and similar in structure. It was noted that the major distinction between the shoreline communities of the Chukchi and Beaufort Seas resulted more from the ratio of habitat-types than from localized distribution of representative species. For example, wide gravelly beaches with Elymus mollis communities were especially common along the Chukchi Sea whereas mud flats with salt marsh vegetation were more frequent along the Beaufort Sea. The plant ecology and floristics of the six habitat-types are discussed. (Sinha-OEIS) W79-05910

PRELIMINARY INVESTIGATIONS OF TROPIC RELATIONSHIPS OF THE ARCTIC SHALLOW WATER MARINE ECOSYSTEM, Western Washington Univ., Bellingham.

D. E. Schneider, and H. Koch.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. V, Receptors—Fish, Littoral, Benthos, p 61-84, Oct. 1978. 4 fig, 4 tab, 3 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder Colorado. 03-5-022-81.

Descriptors: *Plankton, *Benthos, *Primary productivity, *Baseline studies, *Arctic Ocean, *Ecosystems, Alaska, Peat, Resources development, Environmental effects, Water resources, *Outer Continental Shelf, *Trophic relationships.

Preliminary work on trophic relationships has established that primary production by planktonic and benthic microalgae is an important energy input for the Arctic shallow water marine ecosystem. Presumably this input is most important during late spring and summer months, however low populations of viable algal cells apparently remain available even through the winter months. At least some of the animals in this ecosystem ingest vascular plant and moss fragments (peat) that enter the system from the tundra. Presumably this serves as a secondary energy input, but it is difficult at this time to evaluate the relative importance of primary production and detrital input. Substantial microbial activity is associated with the peat and it seems likely that the larger crustaceans and polychaete worms that ingest peat are actually feeding on these microorganisms. At least, that is the view that has emerged from studies of detritus based systems in temperate zone areas. (Sinha-OEIS) W79-05911

BEAUFORT SEA PLANKTON STUDIES,

R. A. Horner.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. V, Receptors—Fish, Littoral, Benthos, p 85-142, October 1978. 4 fig, 9 tab, 68 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-78-B01-6.

Descriptors: *Plankton, *Ecosystems, *Arctic, *Baseline studies, Life history studies, Water pollution effects, Environmental effects, Oil pollution, *Outer Continental Shelf, Beaufort Sea, Petroleum development.

The objectives of this project are to assess the density distribution and environmental requirements of zooplankton and ichthyoplankton in an array of samples of opportunity and to measure phytoplankton activity. Much of the information concerning the distribution and abundance of plankton in the Beaufort Sea in summer needed to assess the impact of oil development is now available. Only a few studies have been done on the effects of oil on truly Arctic species and on species that contribute measurably to the Arctic marine

ecosystem. Potential dangers to the plankton community include reduced primary productivity and possible changes in species composition of the phytoplankton community that might cause changes in zooplankton diversity and therefore affect higher trophic levels. Slow growth and low reproductive rates in the Arctic mean slow recovery following an oil spill. Some life cycle stages, especially larvae, are more susceptible to pollutants than other stages. Thus, if both adults and larvae are destroyed and recruitment from adjacent areas is slow, reestablishment of a community may take considerably longer than in a temperate region. Physical changes in the environment will also affect the organisms living in the Beaufort Sea. Construction of causeways and artificial islands and dredging of channels will change circulation patterns which could affect nutrient supplies and migration and recruitment patterns. Whether these changes will be harmful or beneficial is not known. (Sinha-OEIS) W79-05912

LOWER COOK INLET MEROPLANKTON, Washington Univ., Seattle. Dept. of Oceanography.

T. S. English.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. V, Receptors—Fish, Littoral, Benthos, p 146-372, October 1978. 7 fig, 9 tab, 5 append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-67-TAB.

Descriptors: *Fishes, *Shellfish, *Plankton, *Temporal distribution, *Spatial distribution, *Fisheries, *Spawning, Alaska, Ecology, Oil pollution, Baseline studies, Water pollution effects, Environmental effects, Resources development, *Outer Continental Shelf, *Cook Inlet, Meroplankton, Petroleum development.

The specific objective of this study was to use MARMAP methods to obtain density distribution maps within seasons of eggs and larvae of fishes and shellfishes of major economic significance in Lower Cook Inlet. Quantitative assessments of spatial and temporal distributions and abundance of economically important fishes and shellfishes are of relevance to problems of petroleum development in Lower Cook Inlet. A resource use conflict in Lower Cook Inlet exists between petroleum development and major fisheries harvests. Spawning areas are close to OCS lease areas; local fishermen and the State of Alaska are uneasy about potential damage to the harvests. Studies of early life history stages are important fishery-independent observations: (1) the earliest life history stages allow an assessment of the magnitude of the spawning population, and (2) later, pre-recruit, life history stages allow an assessment of year class strength before exploitation by the fishery. (Sinha-OEIS) W79-05913

ASSESSMENT OF POTENTIAL INTERACTIONS OF MICROORGANISMS AND POLLUTANTS RESULTING FROM PETROLEUM DEVELOPMENT ON THE OUTER CONTINENTAL SHELF OF ALASKA,

Louisville Univ., KY. Dept. of Biology.

R. M. Atlas.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VI, Receptors—Microbiology, p 1-84, October 1978. 32 fig, 7 tab. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-85.

Descriptors: *Microbial degradation, *Oil pollution, *Microorganisms, *Ice, Alaska, Water pollution effects, Aromatic compounds, Baseline studies, Resources development, Environmental effects, *Outer Continental Shelf, Beaufort Sea, Gulf of Alaska, Cook Inlet, Petroleum development, Hydrocarbons, Aliphatic compounds.

The main objectives of this study were to characterize microbial populations in Lower Cook Inlet,

to determine microbial hydrocarbon biodegradation potentials in Lower Cook Inlet, to study degradation of petroleum under ice in the Beaufort Sea, and to study degradation of petroleum in sediment in the Beaufort Sea. In situ experiments were begun and sampled in Elson Lagoon to determine the fate of oil trapped under ice or in sediment. A new Most Probable Number Procedure was developed for enumeration of hydrocarbon utilizing microorganisms. Hydrocarbon utilizing in Cook Inlet were found in higher numbers in Kachemak Bay, near Kennedy entrance and near Upper Cook Inlet than elsewhere in this area. Hydrocarbon biodegradation potentials in Cook Inlet were lower in November than in April. Hexadecane and naphthalene were utilized to a greater extent than pristane and benzantracene, indicating the resistance of highly branched and condensed aromatic hydrocarbons to biodegradation. The numbers of viable heterotrophs enumerated in Cook Inlet were very low compared to Beaufort Sea and lower forty-eight coastal waters. The diversities of heterotrophic bacterial communities in Cook Inlet were high, indicative of a pristine area. The numerical taxonomic studies showed that exposure to oil enriched for hydrocarbon utilizing and that mixtures of hydrocarbons were more readily utilized than individual hydrocarbons. The studies indicate that both simple aliphatic and aromatic compounds are degraded by microorganisms indigenous to areas of the Beaufort Sea, Gulf of Alaska and Cook Inlet. (Sinha-OEIS) W79-05914

STUDY OF MICROBIAL ACTIVITY AND CRUDE OIL-MICROBIAL INTERACTIONS IN THE WATERS AND SEDIMENTS OF COOK INLET AND THE BEAUFORT SEA, Oregon State Univ., Corvallis. Dept. of Microbiology.

R. P. Griffiths, and R. Y. Morita.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VI, Receptors—Microbiology, p 85-178, October 1978. 26 fig, 23 tab, 22 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Sediments, *Nitrogen fixation, *Bacteria, *Oil spills, *Microorganisms, *Microbial degradation, Alaska, Water pollution effects, Environmental effects, Baseline studies, Resources development, *Outer Continental Shelf, Beaufort Sea, Cook Inlet, Crude oil.

During the last year information was obtained about marine microbial function in the Beaufort Sea and Cook Inlet and about the effects of crude oil on specific processes. The microbial functions primarily concerned relative microbial activity and respiration in surface waters and sediments and rates of nitrogen fixation in the sediments. By both field and laboratory observations the effects of crude oil on these processes were estimated. One of the most important findings concerned the potential incorporation of crude oil into the sediments of Cook Inlet and the Shelikof Strait via surface oil spills in the Upper Cook Inlet. It can no longer be assumed that crude oil spills in Cook Inlet would primarily impact only shoreline communities. There is a very real possibility that this oil could be absorbed onto the suspended particulate matter in the water column and carried to the sediments on the west side of the inlet and into the sediments of the Shelikof Strait. The possible long range effects of this on the biological productivity of Cook Inlet is yet to be determined. (Sinha-OEIS) W79-05915

DETERMINE THE FREQUENCY AND PATHOLOGY OF MARINE FISH DISEASES IN THE BERING SEA, GULF OF ALASKA, AND BEAUFORT SEA,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.

B. B. McCain, H. O. Hodgins, A. K. Sparks, and W. D. Gronlund.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investi-

Effects Of Pollution—Group 5C

gators for the Year Ending March 1978, Vol VI, Receptors—Microbiology, p 179-215, October 1978. 14 fig. 2 tab, 15 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Fish diseases, *Pathology, *Water pollution effects, Baseline studies, Alaska, Oil pollution, Environmental effects, Resources development, *Outer Continental Shelf, Gulf of Alaska, Bering Sea, Beaufort Sea.

Four major pathological conditions were found in 6 species of marine fish from the Gulf of Alaska in 1977. The species involved, the type of condition, and the average prevalence and the range of frequencies at the sampling stations of each condition were as follows: Pacific cod (*Gadus macrocephalus*), pseudobranchial tumors, 2.5% (1.0 to 50%); pollock (*Theragra chalcogramma*), pseudobranchial tumors, 0.7% (0.3 to 14.3%); rock sole (*Lepidopsetta bilineata*), epidermal papillomas, 0.2% (0.0 to 0.5%); flathead sole (*Hippoglossoides elassodon*), epidermal papillomas, 0.4% (1.7 to 16.7%); Pacific ocean perch (*Sebastes alutus*), epithelioid tumors, 0.6% (0.2 to 21.0%); and Pacific cod, skin ulcers, 0.9% (0.6 to 46.2%). The geographical distribution of all these conditions, except the tumors of Pacific ocean perch, were concentrated in the northwestern Gulf of Alaska, east and northeast of Kodiak Island. All of the tumors had in common the presence of tumor-specific cells known as X-cells which suggests a common etiology. Possible causes of these tumors include a virus(es), natural or man-made toxic chemical(s), or a single-celled parasite. In the aftermath of possible incidents of crude oil contamination of the Gulf of Alaska, the finding of high frequencies of diseased fish alone will not be sufficient to show the harmful effects of oil. Information has been gained concerning which species are particularly susceptible to diseases and which diseases seem closely correlated or not correlated with man's activities. (Sinha-OEIS) W79-05916

BERING SEA ICE EDGE ECOSYSTEM STUDY: NUTRIENT CYCLING AND ORGANIC MATTER TRANSFER

Alaska Univ., Fairbanks. Inst. of Marine Science. V. Alexander, and R. T. Cooney. In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VI, Receptors—Microbiology, p 216-294, October 1978. 11 fig, 16 tab, 13 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-022-56.

Descriptors: *Phytoplankton, *Ice, *Ecosystems, *Primary productivity, *Water pollution effects, Oil pollution, Environmental effects, Resources development, Baseline studies, Alaska, *Outer Continental Shelf, Bering Sea.

The objectives of this study were to determine the seasonal and spatial dynamics of the Bering Sea phytoplankton production in areas subject to future OCS development, with emphasis on the ice-edge community. The tremendous primary productivity of the Bering Sea is confined to a relatively short productive period of ice free conditions prior to the onset of low light conditions of fall and winter. Under certain conditions the bloom is very intense for an extremely short period of time during which the water column is stripped of nutrients, and at least over the major area of the shelf, most of the production occurs during a 3-4 week period. The major effects of the ice field appear to be in limiting light energy to the water column and reducing windmixing at the surface. This means that water column plant production is probably negligible until the pack begins to break up. While loose ice is present at the sea surface (in the retreating edge zone) it tends to stabilize the windmixed layer and hence, greatly enhances the opportunity for rapid plant production. The very cold ice-related water tends to sink away from the surface as warming progresses. Evidence is presented that algal populations also sink with the water mass. The ramifications of oil contamination are obvious, particularly since a surface spill could

become incorporated and carried to depth with the sinking algal cells to enter benthic food webs on the sea bed. (Sinha-OEIS) W79-05917

REPORT ON ZOOPLANKTON COMMUNITY GRAZING EXPERIMENTS CONDUCTED ON BOARD THE NOAA SHIP, DISCOVERER, IN THE BERING SEA, MAY-JUNE 1977, Alaska Univ., Fairbanks. Inst. of Marine Science. L. Molot.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VI, Receptors—Microbiology, p 295-323, October 1978. 9 fig, 2 tab, 1 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-5-033-56.

Descriptors: *Zooplankton, *Ecosystems, *Nutrients, Baseline studies, Environmental effects, Ice Alaska, Data collections, *Outer Continental Shelf, *Ecological distribution, Community grazing.

Two types of grazing experiments were performed during a cruise to the Bering Sea outer continental shelf in May and June 1977, one monospecific, using various herbivorous species, and the other using natural assemblages. The algae blooms at stations 9, 10, 26 and 27 occurred within the broken ice of the receding ice edge. The blooms were primarily diatoms with peak diameters in the window 51-64 micro m. The bloom at station 39, which occurred much farther south in the open water near Unimak Pass, was primarily Haptophyta (*Phaeocystis* sp.) with a peak diameter in the window 5-6.3 micro m. Grazing rates of particles 4-10 micro m at station 39 could not be calculated due to high background counts induced by line voltage surges. (Sinha-OEIS) W79-05918

BIBLIOGRAPHY ON THE TRANSFER OF SYNTHESIZED ORGANIC MATTER TO ZOOPLANKTON, MICRONEKTON, AND ICHTHYOPLANKTON,

Alaska Univ., Fairbanks. Inst. of Marine Science. V. Alexander, and R. T. Cooney. In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VI, Receptors—Microbiology, p 324-468, October 1978. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, CO. 03-5-022-56.

Descriptors: *Bibliographies, *Plankton, *Baseline studies, Alaska, Nutrients, Water pollution effects, Oil pollution, Environmental effects, Resources development, Primary production, *Outer Continental Shelf, Bering Sea, Chukchi Sea, Gulf of Alaska.

The finished product goes beyond the original task description with the inclusion of references on the following subjects: uptake of organic and inorganic nutrients by primary producers; primary production; trophic interactions, distribution, and population dynamics of marine mammals and seabirds; trophic interactions, population dynamics, and distribution of benthic invertebrates and fishes; the taxonomy and ecology of parasites, of invertebrates and vertebrates; and microbial decomposition of marine organic matter. In general, most of the references apply primarily to the Bering Sea, Chukchi Sea, and northern north Pacific Ocean (with the Kurile-Kamchatka Trench as a southern boundary in the west and the Gulf of Alaska as a southern boundary in the east). The bibliography is arranged alphabetically by author. (Sinha-OEIS) W79-05919

NUTRIENT DYNAMICS IN NEARSHORE UNDER-ICE WATERS,

Alaska Univ., Fairbanks. Inst. of Marine Science. D. M. Schell. In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol VI, Receptors—Microbiology, p 469-496, October

1978. 4 fig, 1 tab, 14 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 3-5-022-56.

Descriptors: *Plankton, *Nutrients, *Energy, *Erosion, *Primary productivity, Coasts, Alaska, Water pollution effects, Baseline studies, Resources development, Environmental effects, *Outer Continental Shelf, Petroleum development, Beaufort Sea.

The preliminary estimates of energy input to the nearshore marine biota shows that within approximately 10 km of shore, over 75% of the carbon is derived from the land and that this carbon is composed primarily of peat-like material that has been accumulating on land for up to 12,000 years. Thus the nearshore marine biome is apparently a 'fossil fuel' subsidized ecosystem wherein the meager annual primary production by ice algae and phytoplankton is heavily supplemented by organic carbon eroded from coastal peat bluffs and transported by river flow into the coastal zone. The implications of oil and gas development on the primary production and secondary production are mostly indirect but potentially great. Development which would increase or decrease shoreline erosion or significantly alter the rate of riverbank erosion or runoff characteristics could be expected to show corresponding impacts on the nearshore zone. (Sinha-OEIS) W79-05920

EFFECTS OF OILING ON TEMPERATURE REGULATION IN SEA OTTERS,

La Jolla, CA. Scripps Institution of Oceanography. G. L. Kooyman, and D. P. Costa. In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VII, Effects, p 1-11, October 1978. 11 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-7-022-35130.

Descriptors: *Mammals, *Metabolism, *Otters, *Water pollution effects, *Oil pollution, Alaska, Resources development, Baseline studies, Environmental effects, *Outer Continental Shelf, Sea otters, Temperature regulation.

The objective of this study was to measure effects of crude oil contamination on sea otters through studies on the changes in the animal's metabolic rate and subcutaneous temperatures before and after contact with oil. A second objective was to attempt to rehabilitate the otters after crude oil contamination. Crude oil contamination over small areas of the sea otter's fur causes noticeable increases in their heat loss and metabolic rate. Oiled sea otters had metabolic rates 1.4X normal. Removal of the crude oil by washing with a detergent resulted in metabolic rates that were 2.3X normal. Crude oil contamination of wild sea otters would probably cause significant thermal stress and could lead to hypothermia and/or pneumonia resulting in death. Rehabilitation of large numbers of sea otters would require sophisticated pre-existing facilities and would be extremely expensive if at all possible. (Sinha-OEIS) W79-05921

SUBLETHAL EFFECTS OF PETROLEUM HYDROCARBONS AND TRACE METALS, INCLUDING BIOTRANSFORMATIONS, AS REFLECTED BY MORPHOLOGICAL, CHEMICAL, PHYSIOLOGICAL, PATHOLOGICAL AND BEHAVIORAL INDICES,

National Marine Fisheries Service, Seattle, WA. Northwestern and Alaska Fisheries Center. D. C. Malins, E. H. Gruger, Jr., H. O. Hodgins, and N. Karrick. In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol VII, Effects, p 12-146, October 1978. 25 fig, 45 tab, 117 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Fish, *Shellfish, *Metabolism, *Pathology, *Water pollution effects, *Oil pollution,

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

Metals, Vertebrates, Invertebrates, Environmental effects, Resources development, Baseline studies, Alaska, *Outer Continental Shelf, *Petroleum hydrocarbons, Hydrocarbons, Sublethal effects.

Primary objectives of this research were to define and evaluate: (1) the alterations in structure of eggs, larvae, livers, and tissues of fish after petroleum exposure; (2) the importance of skin and epidermal mucus in metabolism and disposition of petroleum hydrocarbons in salmonids and flatfish; (3) the uptake, metabolism, and elimination of petroleum aromatic hydrocarbons by salmonids, demersal fish, and shrimp; (4) the effects of toxic trace metals on the metabolism of aromatic hydrocarbons by salmonids and flatfish; (5) the enzymes (aryl hydrocarbon monooxygenases) that metabolize and detoxify or activate aromatic hydrocarbons in a variety of aquatic species; (6) the physiological and embryological effects of aromatic hydrocarbons on early life forms of invertebrates; (7) the pathological effects of exposure of flatfish to crude petroleum-contaminated sediment; (8) the effects of exposures to petroleum on disease resistance of salmonids; and (9) the behavioral responses of vertebrate and invertebrate species exposed to petroleum hydrocarbons. The conclusions of this program are summarized according to disciplinary areas of study. (Sinha-OEIS)

W79-05922

EFFECTS OF PETROLEUM EXPOSURE ON THE BREEDING ECOLOGY OF THE GULF OF ALASKA HERRING GULL GROUP AND REPRODUCTIVE ECOLOGY OF LARGE GULLS IN THE NORTHEAST GULF OF ALASKA,

John Hopkins Univ., Baltimore, MD. Dept. of Pathobiology.

S. M. Patten, Jr., and L. R. Patten.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VII, Effects, p 151-309, October 1978. 72 fig. 22 tab, 46 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Oil pollution, *Gulls, *Breeding, *Ecology, *Reproduction, Oil spills, Water pollution effects, Environmental effects, Baseline studies, Resources development, Alaska, *Outer Continental Shelf, Petroleum, Gulf of Alaska, Larus, Herring gulls.

An investigation of primary and potential secondary effects of gas and oil development on large gulls (Larus) in the northeast Gulf of Alaska is reported. Conclusions are: very small amounts of North Slope (Prudhoe Bay) Crude Oil exposure to gull eggs in the field, at early stages of incubation, lead to high embryonic mortality. Embryonic resistance to petroleum exposure increases with the duration of incubation. Mineral oil (control) in equivalent microliter doses causes no significant mortality. Gull behavior is altered by the continued incubation of eggs dead from petroleum exposure. Adult gulls fail to respond with the normal production of replacement clutches, which normally follow clutch loss to natural causes. The combination of high egg mortality and alteration of adult behavior virtually eliminates gull reproduction in the experimentally oiled area. (Sinha-OEIS)

W79-05923

INFLUENCE OF PETROLEUM ON EGG FORMATION AND EMBRYONIC DEVELOPMENT IN SEABIRDS,

Point Reyes Bird Observatory, Stinson Beach, CA. D. G. Ainley, C. R. Grau, S. H. Morrell, T. Roudybush, and R. R. LeValley.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VII, Effects, p 310-333, October 1978. 4 fig. 4 tab, 30 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Birds, *Reproduction, *Oil pollution, *Water pollution effects, Embryos, Alaska, California, Baseline studies, Environmental effects, Resources development, *Outer Continental Shelf,

Petroleum development, Larus, Ptychoramphus aleuticus, Food supply.

The effects that brief exposure to an oil spill would have on the reproduction of Cassin's Auklets (Ptychoramphus aleuticus) and on Western Gulls (Larus occidentalis) nesting on the Farallon Islands of California were studied. These species are representative of many birds breeding in Alaska and the lower Pacific Coast states that are at risk from oil pollution during the reproductive period. It is not possible to draw definitive conclusions from the results obtained during this first year of study in which auklets were dosed with small amounts of bunker C oil. However, under the conditions of the experiment, the oil did not cause any apparent adverse effects on reproduction of auklets such as those that were obtained when comparable doses were given to laboratory quail. This does not mean, however, that oil is harmless to seabirds. The experiment was designed to minimize general effects of oil and to maximize unique features of reproduction that might reveal subtle effects of oil instead of gross and multiple stresses such as those observed in massive spills. Furthermore, oil doses had to be given to the female several hours after the time of feeding, a condition that would be unlikely in the event of an inadvertent spill at a feeding area. If auklets, gulls, or murres are subjected to foods contaminated by oil, they are likely to be able to deal with this oil by rapid elimination through the gut (auklets, murres) or by regurgitation (murres, gulls), and that oil will probably not constitute a hazard, provided other, noncontaminated food becomes available in a reasonable time. (Sinha-OEIS)

W79-05924

COMPOSITION AND SOURCE IDENTIFICATION OF ORGANIC DETRITUS IN LOWER COOK INLET,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.

J. D. Larrance.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VII, Effects, p 334-349, October 1978. 2 fig. 2 tab, 17 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Oil pollution, *Fisheries, Shellfish, *Water pollution effects, *Plankton, *Detritus, Benthos, Alaska, Resources development, Baseline studies, *Outer Continental Shelf, *Cook Inlet, Petroleum development, Food web.

Offshore petroleum development in lower Cook Inlet will provide a potential source of contamination of the environment by accidental large spills and chronic low-level oil pollution. Such pollution would undoubtedly have a harmful effect on important commercial fisheries in lower Cook Inlet. Benthic species harvested include snow, king, and Dungeness crab, shrimp, razor clams, and scallops. These are commercially harvested primarily within the rectangle bordered by Anchor Point, Kachemak Bay, the Barren Islands, and Kamishak Bay. Some primary king crab recruitment grounds are within this area in the Bluff Point-Kachemak Bay region. The larval stages of these and other benthic species are planktonic and rely on phytoplankton as food, Adults in the benthic community ultimately depend on organic production from phytoplankton and other plants. Phytoplankton grazed by zooplankton enters the detrital food web via fecal pellet deposition. Other cells enter the benthos by sinking directly. As small sinking particles, the cells and pellets may act to transport oil from the surface to the bottom. Studies have indicated rapid removal and dispersal of surface oil by suspended particles. When oil enters seawater, emulsions of very tiny droplets can form. Some of the droplets become bound to particles by absorption and adsorption; they subsequently sink directly or are sedimented in fecal pellets after being ingested by zooplankton. Thus, ingestion and sorption act as precipitation mechanisms to transfer otherwise buoyant oil particles to the detrital food web. (Sinha-OEIS)

W79-05925

RESEARCH TO DETERMINE THE ACCUMULATION OF ORGANIC CONSTITUENTS AND HEAVY METALS FROM PETROLEUM-IMPACTED SEDIMENTS BY MARINE DETRITIVORES OF THE ALASKAN OUTER CONTINENTAL SHELF,

Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.

J. W. Anderson, J. M. Augenfied, E. A. Crecelius, and R. Riley.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VII, Effects, p 350-403, October 1978. 2 fig. 12 tab, 45 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 2311102778.

Descriptors: *Sediments, *Trace elements, *Benthos, *Food chain, *Oil pollution, *Heavy metals, Alaska, Water pollution effects, Environmental effects, Resources development, Baseline studies, *Outer Continental Shelf, *Detritivores, Petroleum hydrocarbons, Hydrocarbons, Macoma inquinata, Phascolosoma agassizii, Abarenicola pacifica.

During FY1977 and 1978, experiments were conducted to examine the bioavailability of petroleum hydrocarbons and trace metals from petroleum-impacted marine sediments. The feasibility of using bivalve condition index and free amino acid pool as indicators of stress due to petroleum exposure was also tested. Prudhoe Bay crude was the test oil in all experiments. Results suggest that mode of feeding is a determinate factor in the availability of sediment-sorbed hydrocarbons to benthic animals. Short-term experiments with ¹⁴C-labeled specific aromatic hydrocarbons in the laboratory indicated that ingestion of contaminated sediment resulted in negligible uptake of 2-methylnaphthalene by Macoma inquinata. Uptake of ¹⁴C-phenanthrene, -dimethylbenzanthracene, and -benzo(a)pyrene, however, exhibited components which could be attributed to both direct uptake from sediment and uptake from seawater. Magnification factors showed that hydrocarbons were concentrated from seawater but not from sediment. Both free amino acid content and condition index of Macoma inquinata were sensitive to stress, as they showed significant reductions, compared to control animals, during field exposure to oil sediment. Compared to sediment concentrations, nickel, copper, zinc, and manganese were elevated in Phascolosoma agassizii, and nickel, zinc, and selenium in Macoma inquinata. Recent research with a mud-ingesting polychaete, Abarenicola pacifica, indicates that this species takes up and retains more phenanthrene than naphthalenes. It has been possible to detect behavioral modifications, ingestion rate reduction, and decreases in phenanthrene content of sediment after passage through the gut. (Sinha-OEIS)

W79-05926

BEAUFORT SEA BARRIER ISLAND-LAGOON ECOLOGICAL PROCESS STUDIES. OVERVIEW AND SYNTHESIS,

LGL Ltd.-U.S., Inc. Bryan, TX.

J. C. Truett.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol. VII, Effects, p 404-406, October 1978. 4 fig. 4 tab, append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado. 03-6-022-35193.

Descriptors: *Coasts, *Birds, *Fish, *Invertebrates, *Water pollution effects, Alaska, Resources development, Baseline studies, *Outer Continental Shelf, *Beaufort Sea, Petroleum development, Food supply.

This study of a coastal area of the Beaufort Sea in Alaska analyzes the critical system processes (patterns of change) to provide information that can be used to assess the impacts of activities related to

petroleum research in nearshore currents at temperatures least local that bound will ultimately know reduce the waters can by reducing source. The reduction of systems c fish), or c by affecting mary food W79-05927

BEAUFORT ECOLOGICAL LGL Ltd. S. R. John In: Environmental Shelf Environmental Effects, p ref, append. W79-05928

Descriptor: Environmental poral distribution, Oil Shelf, Baseline development

The research uses/depending feeding evaluated habitats at habitats. G city was rained from of development this time create operate by nearshore use of near open-water ry use of migrating ing glaucous intensive development during this following may potent imposing birds, distribution destruction predators), biological circulation and cyclin successful feeding, at degree of W79-05929

BEAUFORT ECOLOGICAL OF FISHERIES LGL Ltd. P. C. Craig In: Environmental Shelf Environmental Effects, p ref. NOAA Environmental Assessment

Descriptor: Ecology, *Habitat effects

Waste Treatment Processes—Group 5D

petroleum development. The implications of these research findings to petroleum development in the nearshore zone include the following: Nearshore currents and water quality parameters (salinity, temperature, etc.) will probably be modified (at least locally) by major changes in the landforms that bound the system. Whether the birds and fish will ultimately be affected by such changes is not yet known. Shoreline stabilization practices that reduce the organic detritus input into nearshore waters could conceivably affect the fish and birds by reducing the availability of an important energy source. This hypothesis has yet to be tested. Introduction of contaminants (e.g., oil) into nearshore systems could directly affect birds (and perhaps fish), or could indirectly affect both birds and fish by affecting the epibenthic invertebrates—their primary food source. (Sinha-OEIS)
W79-05927

BEAUFORT SEA BARRIER ISLAND-LAGOON ECOLOGICAL PROCESS STUDIES. AVIAN ECOLOGY IN SIMPSON LAGOON, 1977.
LGL Ltd., Edmonton (Alberta).
S. R. Johnson.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol VII, Effects, p 467-586, October 1978. 3 fig, 25 tab, 73 ref, append. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Birds, *Habitats, *Ecology, *Environmental effects, *Resources development, Temporal distribution, Migrations, Water pollution effects, Oil pollution, Alaska, *Outer Continental Shelf, Beaufort Sea, Simpson Lagoon, Petroleum development, Ecological distribution.

The research program addresses four ecosystem uses/dependencies of birds—for migration, breeding, feeding and staging-molting. These uses are evaluated as they relate to barrier island-lagoon habitats and predicted development alterations of habitats. General conclusions were that: Bird activity was minimal while the nearshore areas remained frozen in early summer; potential impacts of development are therefore probably also low at this time except for those activities which would create open water. Nearshore area were used moderately by birds after breakup began but before the nearshore became completely ice-free. Heaviest use of nearshore areas by birds occurred during the open-water season—August and September. Primary use of the area at this time was by molting and migrating oldsquaws, staging shorebirds, and staging glaucous gulls. Feeding activity in the area was intensive by all these birds. Potential impacts of development may, therefore, be most serious during this open-water season. Industrial activity following petroleum leasing of nearshore waters may potentially affect birds in two major ways: by imposing direct mortality or stress (e.g., oiling of birds, disturbance caused by aircraft overflights, destruction of nesting habitat, or introduction of predators); and by interrupting key physical and biological processes (e.g., coastal erosion, water circulation, nutrient and invertebrate production and cycling, etc.) that currently enable birds to successfully use the area for migration, breeding, feeding, staging and/or molting, or that affect the degree of mortality or stress. (Sinha-OEIS)
W79-05928

BEAUFORT SEA BARRIER ISLAND-LAGOON ECOLOGICAL PROCESS STUDIES. ECOLOGY OF FISHES IN SIMPSON LAGOON, 1977.
LGL Ltd., Nanaimo (British Columbia).
P. C. Craig, and W. Griffiths.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol VII, Effects, p 587-664, October 1978. 19 fig, 13 tab, 34 ref. NOAA, Outer Continental Shelf Environmental Assessment Program, Boulder, Colorado.

Descriptors: *Fish, *Ecosystems, *Coasts, *Ecology, *Habitats, Oil pollution, Alaska, Water pollution effects, Resources development, Environmen-

tal effects, Baseline studies, *Outer Continental Shelf, Beaufort Sea, Simpson Lagoon, Petroleum development, Feeding grounds.

The Simpson Lagoon fisheries program addresses the role of nearshore fishes in barrier island-lagoon ecosystem on Alaska's Beaufort Sea coast. Study objectives were to identify important biological processes and habitats of fish, and assess their vulnerability to OCS petroleum development. Simpson Lagoon and other nearshore habitats are used by fish for one overriding purpose, namely feeding on the abundant nearshore food supply. Each spring as the ice melts, anadromous and marine fishes invade nearshore waters and feed extensively on epibenthic invertebrates (organisms living on or near bottom substrates). The fish accumulate food reserves for spawning and/or overwintering requirements. Several factors influencing the numbers and distribution of fish were examined but predators, parasites and food were not considered to be limiting factors for fish inhabiting nearshore waters. It appears instead that populations of nearshore fishes, particularly the anadromous species used by man, are limited by factors operative outside the nearshore environment (e.g., overwintering areas in North Slope rivers). If this interpretation is correct, the implication is that, while nearshore habitats are essential feeding areas for fish, nearshore biological processes and habitats are less vulnerable to impacts of OCS petroleum development than other locations or stages in the life cycles of key fish species. (Sinha-OEIS)
W79-05929

BEAUFORT SEA BARRIER ISLAND-LAGOON ECOLOGICAL PROCESS STUDIES. INVERTEBRATES IN SIMPSON LAGOON, 1977.
LGL Ltd., Edmonton (Alberta).
W. Griffiths, and P. C. Craig.

In: Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1978, Vol VII, p 665-757, October 1978. 10 fig, 15 tab, 44 ref, 4 append. Boulder, CO.

Descriptors: *Invertebrates, *Biomass, *Abundance, *Alaska, *Oil pollution, Baseline studies, Resources development, Water pollution effects, *Environmental effects, Temporal distribution, Spatial distribution, *Outer Continental Shelf, Beaufort Sea, Ecological distribution, Petroleum development, Simpson Lagoon.

The invertebrate investigations in the Simpson Lagoon area on the Alaskan Beaufort Sea Coast in 1977 were concentrated on those organisms identified as important food items to higher trophic levels (fish and birds). The main objectives of this year's research were to determine the seasonal and habitat distributions, abundances and biomasses of these important organisms. Diver observations showed that mysids and amphipods were the most abundant invertebrate groups in Simpson Lagoon in terms of numbers and biomass. A major potential cause of insult related to OCS petroleum development might be contaminant (e.g., oil) introductions. In the nearshore environment, invertebrates could be affected by oil in the water column or (probably more critical to epibenthos) by oil on and in benthic substrates. Adverse impacts of oil on invertebrates might affect the fish and birds that depend on those invertebrates for food. (Sinha-OEIS)
W79-05930

5D. Waste Treatment Processes

WATER EXTRACTION FROM BLACK LIQUORS (EKSTRAKTSIYA VODY IZ RASTVOROV CHERNOGO SHCHELOKA).
L. A. Kul'skii, T. V. Knyaz'kova, and N. A. Linchikovskaya.

Khimicheskaya Tekhnologiya, No. 2, p 48-50, March/April, 1978. 2 fig, 4 ref, 2 tab.

Descriptors: *Black liquor, *Separation techniques, *Water conservation, Pulp wastes, Wastes, Industrial wastes, Water pollution sources, Pulp and

paper industry, Effluents, Solvents, Organic compounds, Triethylamine, Solvent extraction, Water pollution control, Pollution abatement, Kraft mills.

An attempt has been made to determine whether water can be efficiently extracted from kraft mill black liquor with an organic solvent (triethylamine) (TEA). Distribution coefficients were determined for mineral and organic components and water in black liquor containing 34.2 g/liter of solids and of TEA after mixing equal volumes of black liquor and TEA and allowing the two phases to separate at 5.5-20.0°C. The same determinations were made for black liquors containing 4.27-34.2 g/liter of solids at 15-18°C. The experimental data indicated that removing water from the black liquor was more efficient than removing mineral impurities. (Chern-IPC)
W79-05502

WATER QUALITY IMPROVEMENTS FROM UPGRADED WASTE TREATMENT.

Virginia State Water Control Board, Richmond.
K. C. Das, and J. J. Cibulka.
Journal Water Pollution Control Federation, Vol. 50, No. 10, p 2276-2288, October, 1978. 10 fig, 5 ref, 6 tab.

Descriptors: *Water quality, *James River (Virginia), Water pollution effects, Biochemical oxygen demand, Temperature, Dissolved oxygen, Coliforms, Bacteria, Virginia, Pulp wastes, Pulp and paper industry, Effluents, Wastes, Industrial wastes, Water pollution sources, Estuaries, Pulp wastes, Sewage treatment, Surface runoff, Runoff, Organic compound, Pollution abatement.

BOD, temperature, dissolved oxygen (DO), and fecal coliform concentration data, obtained in 1975, are tabulated and graphed for designated sites along the upper fresh-water tidal portion of the James River (Virginia) estuary. This portion of the river receives effluents from a paper company, two (Richmond and Chesterfield) County sewage treatment plants, and a cellophane/synthetic fibers mill. The data indicate that there is a marked improvement in the DO concentration as a result of a significant reduction in the amount of oxygen-demanding carbonaceous materials in the estuary portion of the test reach. This improvement has resulted largely from the recent advent of secondary treatment of the city's discharge and the termination of a discharge by a second paper mill. The quantity of nitrogenous BOD discharged into the river is significant and could have severe impact during extreme drought conditions. At present, approximately 3,600 kg/day (8,000 lb/day) of carbonaceous BOD is discharged in waste waters, compared to ca. 10,000 kg/day (22,000 lb/day) of nitrogenous BOD. The reduction of fecal coliform organisms in the river reach can be attributed in part to improvements in overall waste water treatment, including chlorination. Deoxygenation rate constants have been altered in the reach under consideration. The introduction of secondary treatment at the city's waste water treatment plant, treatment upgrading by one paper company, and elimination of discharges by a second paper company may all contribute to this alteration. BOD loading increased with freshwater inflow to the estuary, possibly because of organics entering the river with runoff. (Swichtenberg-IPC)
W79-05503

FOLLUM (FABRIKKER A/S, NORWAY) HAS FULFILLED ANTIPOLLUTION DEMANDS (FOLLUM HAR OPPFYLT UTSLEPPSKRAVENE).

K. J. Gurandrud.
Norsk Skogindustri, Vol. 32, No. 10, p 224-225, October, 1978. 3 fig.

Descriptors: *Pulp wastes, *Waste water treatment, *Treatment facilities, Equipment, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Pulp and paper industry, Effluents, Foreign countries, Sludge, Filters, Water consumption (Except consumptive use), Sedimentation, Norway, Europe.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

The Follum pulp mill's effluent-treating and pollution-control installation centers around a circular sedimentation basin (38 m diameter, 4.5 m deep, ca. 5000 cu m volume) which can clean ca. 15 cu m effluent/min. Sedimented sludge is concentrated from 2% to 20-25% consistency in an Eimco belt vacuum filter. Since startup of the installation, freshwater consumption at the mill has been halved. (Brown-IPC)
W79-05504

COMBINED EFFLUENTS FROM THREE MILLS ARE HANDLED BY SINGLE NEW FACILITY.
Consolidated Papers Inc., Wisconsin Rapids, WI. S. Martin.
Pulp and Paper, Vol. 52, No. 11, p 186-187, October, 1978. 1 illus.

Descriptors: *Pulp wastes, *Waste water treatment, Wisconsin River (Wisconsin), Wastes, Industrial wastes, Water pollution treatment, Water pollution sources, Waste treatment, Pulp and paper industry, Effluents, Wisconsin, Biological treatment, Pipelines, Suspended solids, Biochemical oxygen demand, Sludge treatment, Dewatering, Sludge, Landfills, Outlets, Clarifiers, Coated paper, Fiberglass, Kraft mills, Pollution abatement.

Effluent from the Kraft Division (bleached kraft pulp mill), Wisconsin Rapids Division, and Biron Division (both coated paper mills) of Consolidated Papers Inc. is pumped via a system of six miles of reinforced fiberglass pipe to the water quality center for primary and secondary treatment. The treatment system consists of lift-pumping stations at each of the three divisions, a primary treatment stage to reduce suspended solids, a biological treatment stage to reduce the quantity of BOD, secondary clarifiers to remove solids, sludge dewatering presses, a landfill, and a submerged outfall to the Wisconsin River. Typical BOD loadings to the lagoons have been 54,477 lb/day, whereas effluent discharges contain only 3,434 lb/day. (Swichtenberg-IPC)
W79-05507

MEMBRANE PROCESSES FOR ENVIRONMENTAL STUDIES.
D. Freilich.
Swedish Water and Air Pollution Research Institute, Technical Report No B 481, January 1979. 31 p, 3 fig, 3 tab, 15 ref.

Descriptors: *Membrane processes, *Waste water treatment, *Industrial wastes, *Pulp and paper industry, *Textiles, *Water pollution control, *Filtration, Reverse osmosis, Hyperfiltration, Ultrafiltration, Pollutants, Costs, Capital costs, Operating costs, Costs, Economic feasibility, Effluents, Dynamic membranes, Membranes, Equipment.

As part of a project on the use of dynamic membranes for wastewater treatment, different classes of membranes are briefly surveyed with emphasis on dynamic membranes, and treatment of industrial wastewaters by membrane processes in the pulp and paper and textile industries is reviewed. Most applications are concerned with concentration of effluents, but processes can be made economically feasible through reuse of chemicals. Removal of dissolved low-molecular-weight solutes by filtering them from water under pressure through membranes (reverse osmosis or hyperfiltration) can be considered an extension of ultrafiltration, in which particles of colloidal dimensions are filtered from disperse systems. In the highly specific membrane process it is best to use decentralized feeds with one or few pollutants, whereas in conventional treatment centralized feeds can be used. Membrane separation processes are useful in the pulp and paper, textile, food, metal washing and electroplating, and electrochemical and chemical industries. Advantages of dynamic membranes: (1) high water fluxes, (2) generation and regeneration in-situ, (3) use with high temperature and corrosive feeds, and (4) relatively low capital and operation costs. Dynamic membranes are a relatively new type, related to composite membranes. Thin layers of neutral or ion-exchange materials are formed in the pores

on the surface of finely porous substrates by filtering pressurized solutions of additive. (Lynch-Wisconsin)
W79-05735

CHEMISTRY OF NITRIFICATION-DENITRIFICATION PROCESS.
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Mechanical Engineering.
L. K. Wang, C. P. C. Poon, M. H. Wang, and J. Bergenthal.
The Journal of Environmental Sciences, Vol. 21, No. 6, p 23-28, November-December 1978. 21 ref.

Descriptors: *Chemistry, *Nitrification, *Denitrification, *Activated sludge, *Respiration, *Equations, *Sewage treatment, Nitrogen, Stoichiometry, Nitrogenous oxygen demand, Water pollution sources, Treatment facilities, Nitrates, Nitrites, Ammonia, Carbon, Bacteria, Alkalinity.

General stoichiometric equations are given for nitrification-denitrification reaction, chemistry, and respiration; the significance of nitrification and denitrification phenomena in activated sludge sewage treatment processes and in receiving waters is also discussed; current important design criteria for the nitrification-denitrification process are reviewed. New stoichiometric nitrification equations are presented in which alkalinity, in terms of HCO_3^- , is included as an important parameter. The equations not only predict the same stoichiometric oxygen requirements which have been reported earlier, but further predict the amount of alkalinity needed in process water to maintain nitrification. Neutralization reactions in the nitrification process are also proposed which predict that one mole calcium bicarbonate is needed to neutralize every two moles nitric acid produced. Stoichiometric denitrification equations are presented which consider C sub-a-H sub-b-0 sub-c to be the general molecular formula of the carbon source to be utilized in a biological denitrification process. The general stoichiometric respiration equations assume C sub-a -H sub-b-0 sub-c -N sub-d -P sub-e -S sub-f to be the organic matter to be biologically oxidized. Since 1970 the importance of nitrification has again been recognized, as U.S. engineers now consider both BOD and NOD (nitrogenous oxygen demand) as potential loads of stream pollution. (Lynch-Wisconsin)
W79-05737

SOLIDS CONTROL IN EFFLUENTS FROM AERATED LAGOON SYSTEMS.
Clemson Univ., SC. Water Resources Research Inst.
L. G. Rich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 542, Price codes: A06 in paper copy, A01 in microfiche. Report No 73, 1978. 105 p, 28 fig, 21 tab, 34 ref, 2 append. OWRT B-105-SC(1).

Descriptors: *Lagoons, Aerated lagoons, *Suspended solids, Wastewater treatment, Municipal wastewater, Biochemical oxygen demand, South Carolina.

In South Carolina, as well as in other states in the Southeast, wide use has been made of aerated lagoon systems to treat municipal wastewater discharges of less than one million gallons per day. These systems fall in the category of low-cost, low-energy, and low-maintenance treatment technology which is ideal for such application. Unfortunately, however, the performance of existing aerated lagoon systems fails to meet the requirements of the 1977 effluent standards on a consistent basis. The failure centers primarily on the suspended solids discharged from the lagoon and the biochemical oxygen demand exerted by the solids. This report describes (1) a field investigation to provide a more definitive knowledge of the performance of existing aerated lagoon systems serving municipalities in the Piedmont region of South Carolina, (2) a laboratory investigation to obtain a better understanding of the settling characteristics of bacterial biomass solids in suspensions with concentrations similar to those encountered in aerated

lagoon effluents, and (3) an engineering study to develop criteria for the design of aerated lagoon systems capable of improved performance with respect to effluent suspended solids. The engineering study involved the analysis of data obtained from the field and laboratory investigations, as well as information derived from the literature.
W79-05828

ADSORPTION OF VIRUS ON ACTIVATED CARBON UNDER VARYING WATER CHEMISTRY CONDITIONS.
Maryland Univ., College Park. Water Resources Research Center.
R. P. Healy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 530, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 32(2), (1975), 64 p, 21 fig, 6 tab, 22 ref. OWRT A-023, MD(1). 14-31-0001-5020.

Descriptors: *Viruses, *Activated carbon, *Sewage effluent, Virus adsorption, Mathematical models.

The purpose is to investigate the adsorption of virus on activated carbon from waters of different solution chemistry such that design parameters for carbon columns can be determined. Column tests are conducted with viruses suspended in chemically known buffer solution, tap water, and secondary sewage effluent. Adsorption of virus from the buffer solution and the secondary effluent obeys Langmuir and Freundlich isotherms. For a virus concentration of 10 to the fifth power-10 to the sixth power PFU/ml in the buffer solution, the carbon monolayer capacity is 3.39×10 to the fifth power PFU/mg and the equilibrium constant is 9.97×10 to the seventh power ml/PFU. In secondary effluent this same virus concentration gave a carbon capacity of 1.28×10 to the fifth power PFU/mg and an equilibrium constant of 6.27×10 to the minus fifth power ml/PFU. At a reduced virus concentration of 1000 - 10,000 PFU/ml, in secondary effluent, the carbon capacity if 2.54×1000 PFU/mg and the equilibrium constant is 3.52×10 to the minus fourth power ml/PFU. Thus, the carbon capacity varies with the virus concentration in solution when suspended in secondary sewage effluent. Organics in secondary effluent may compete with the virus for the available adsorption sites on the carbon. The adsorption on carbon was reduced in secondary effluent as compared with the buffer solution. A virus concentration of 10 to the fifth power-10 to the sixth power PFU/ml in tap water did not represent adsorption conditions in this study. This appears to be due to the dispersion of virus agglomerates that were present in the virus preparation. The competition of effluent organics and virus for adsorption sites causes the experimental virus concentration displacement curves to be different than the theoretical curve as expressed by the mathematical model tested in this study. The column breakthrough curves illustrate that a steady condition with regard to the development of a virus concentration profile does not readily occur.
W79-05831

TECHNOLOGY AND ECONOMICS OF INDUSTRIAL POLLUTION ABATEMENT.
Illinois Inst. for Environmental Quality, Chicago.
For primary bibliographic entry see Field 5B.
W79-05865

REMOVAL OF COLOR, DETERGENTS, AND OTHER REFRACTORY SUBSTANCES FROM TEXTILE WASTEWATER.
Institute of Meteorology and Water Management, Krakow (Poland).
J. Kurbiel.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 242, Price codes: A21 in paper copy, A01 in microfiche. Report No. EPA-600/2-78-072, March 1978. 488 p, 135 fig, 125 tab, 81 ref, 3 append. PR-5-332-3.

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Waste Treatment Processes—Group 5D

Descriptors: *Waste water treatment, *Tertiary treatment, *Industrial wastes, *Textiles, *Municipal wastes, *Waste water, *Biological treatment, *Activated sludge, *Water pollution treatment, *Filtration, *Coagulation, *Adsorption, *Oxidation, *Ion exchange, *Reverse osmosis, *Activated carbon, *Pollutants, *Water purification, *Separation techniques, *Economic feasibility.

Laboratory and pilot scale research was carried out to determine the effectiveness and economic feasibility of selected physicochemical treatment processes for removing color, detergents and other refractory pollutants from mixed textile and municipal waste water previously treated with activated sludge. The following tertiary processes were studied individually and in combined systems: filtration on single and dual media filters, conventional and contact coagulation, adsorption on granular activated carbon, oxidation with ozone, ion exchange on anionic and cationic resins, and hyperfiltration (reverse osmosis). Although the results indicate that the treatments effectively removed the individual pollutants, the feasibility of the processes determined by economic factors, energy consumption, and technical availability differs. The hyperfiltration process was the most energy intensive. Ion exchange revealed poor COD removal and a great amount of post-regeneration waste water. The most effective combined treatment was contact coagulation on upflow filters and dual media filtration which was preceded by chlorination with NaOCl and followed by adsorption on activated carbon. (Davison-IPA)

W79-05867

WATER TREATMENT.

Laporte Industries Ltd., London (England). (Assignee).

W. H. Redmayne, and D. Berry.

U.S. Patent No. 4,131,545, 3 p, 2 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 4, p 1220, December 26, 1978.

Descriptors: *Patents, *Water treatment, *Waste water treatment, *Water pollution treatment, *Water purification, *Water quality control, *Chemicals, *Inorganic chemicals, *Phosphates, *Potable water, *Aluminum.

Phosphate containing basic aluminum solutions are provided by reaction aluminum sulphate solution with phosphoric acid, adding chloride, basifying by precipitation of calcium sulphate from solution and cooling the resultant solution in a controlled manner. Preferably addition of chloride and basification occurs at a temperature of 80-90°C and the solution is cooled to below 60°C soon after the basifying salts have been introduced. The solutions, preferably diluted to an aluminum content of 1 to 2% Al_2O_3 are useful for clarifying water and dewatering sewage sludge. Potable water which has been treated in this way is often stored in reservoirs and water extracted from sludges is recycled through the sewage treatment plant, the outflow from which is usually discharged into nearby rivers or canals. It would be expected that any treatment of water which included phosphate could lead to eutrophication problems. However, it has been found that in general the phosphate is retained in flocs formed during the water treatment, and is thus not released to any substantial extent into the water supplies. In fact treatment with basic aluminum solutions according to the invention tends to lead in general to the lowering of phosphate levels in the water treated. (Sinha-OEIS)

W79-05948

SEWAGE OSMOSIS SYSTEM,

Sewage Osmosis Inc., Minneapolis, MN. (Assignee).

E. C. Peterson, and F. P. Coolbroth.

U.S. Patent No. 4,132,625, 6 p, 2 fig, 10 ref; Official Gazette of the United States Patent Office, Vol. 978, No. 1, p 230, January 2, 1979.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, *Waste water disposal, *Soil

disposal fields, *Anodes, *Cathodes, *Electric fields, *Rocks, *Dolomite, *Carbon, *Absorption, *Coke.

A system is described for dispersing aqueous effluents from a sewage treatment system utilizing a generally closed septic or sewage retention tank and a subterranean disposal field area for receiving the discharge from the septic tank. The septic tank is arranged to receive raw sewage and to retain solids and ultimately discharge aqueous fluid effluent into the disposal field area which is placed next to the septic tank vessel. Anode means and cathode means are arranged generally laterally of the disposal field with the anodes and cathodes being disposed on opposite sides of the disposal field. The anodes consist essentially of independent cells of crushed raw rock dolomite, hard limestone, or basalt, each of which is a naturally-occurring mineral. An additive of fused dolomite powder is preferably added to each of the anodes, in a suitable quantity as required. The cathodes consist essentially of a material high in carbon content, preferably coke screenings. The anodes and cathodes combine to establish an electrical field across the disposal field, and assist in dispersing the effluent into the soil and ground. (Sinha-OEIS)

W79-05950

METHOD AND APPARATUS FOR REMOVING FILTERABLE SUBSTANCES FROM A LIQUID.

Ifo Sanitar A. B., Bromolla (Sweden). (Assignee). K. A. G. Olsson, K. P. E. Astrom, and J. C. Johansson.

U.S. Patent No. 4,131,546, 7 p, 2 fig, 3 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 4, p 1221, December 26, 1978.

Descriptors: *Patents, *Waste water treatment, *Filtration, *Separation techniques, *Water pollution treatment, *Pulp and paper industry, *Domestic wastes, *Equipment.

Small particles which occur in digested sludge or sludge formed in a wet aerobic digestion process for sanitary treatment of domestic waste in water, or fibers (including very fine fibers, so-called micro-fibers) in water from the pulp and paper industries can be separated by means of a specially arranged filter which has a very large total surface and may be removed in a unique way as it is used. The water is caused to pass radially through a cylindrical roll of web-formed wet-strength fiber material. By drawing out the fiber web at only low speed from the innermost turn of the roll through the central cavity of the roll, the effect is achieved that the roll continuously exposes a relatively clean filtering surface to the liquid. When the fiber web with the substances collected from the liquid is drawn out from the central cavity of the fiber web roll, the web is for natural reasons twisted to form a spiral. The twisting movement of the fiber web is utilized to form as it moves further away from the roll, a steadily tighter spiral for enclosing and 'packaging' the substances normally being solids but may also be fats and oils or other fluid or semi-fluid. The fiber web roll may be placed in a container or may be air-dried or may be disintegrated before being disposed of. (Sinha-OEIS)

W79-05955

REMOVING COAGULABLE SUBSTANCES FROM AN AQUEOUS MEDIUM,

Wafilin B.V., Swolle (Netherlands). (Assignee).

W. J. de Putter.

U.S. Patent No. 4,131,541, 5 p, 1 fig, 7 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 4, p 1219, December 26, 1978.

Descriptors: *Patents, *Waste water treatment, *Food processing industry, *Proteins, *Separation techniques, *Water pollution treatment, *Organic compounds, *Organic wastes, *Odor, *Filtration, *Membrane processes, *Water reuse.

Proteins from potato fruit waste water produced in processing potatoes for the production of potato starch give rise to fermentation symptoms when the water is discharged to surface water and to development of a disagreeable smell. A very

simple method for removing these proteins from waste water is a heating treatment, after which the coagulable proteins precipitate and can be filtered off. This invention provides a method so that any risk of fermentation or other microbiological processes is excluded or at least decreased. This is achieved by the arrangement that the aqueous medium prior to heating is subjected to an ultra filtration with a pressure ranging from 5 to 15 Atm. and in that the protein concentration is increased preferably to a value of at least 4%. In such membrane filtrations the aqueous medium is passed along a membrane which is permeable for water but not for proteins and other high molecular substances, which causes a concentration of proteins and other substances in the discharged medium, while permeate in the form of pure water or water containing low molecular weight substances as a permeate is obtained. This pure water or aqueous solution can again be used in the process of producing potato starch from potatoes. (Sinha-OEIS)

W79-05956

PROCESS AND APPARATUS FOR REMOVAL OF CONTAMINANTS FROM WATER,

Westinghouse Electric Corp., Pittsburgh, PA. (Assignee).

K. Moeglich.

U.S. Patent No. 4,131,526, 11 p, 4 fig, 9 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 4, p 1215, December 26, 1978.

Descriptors: *Patents, *Water treatment, *Waste water treatment, *Water purification, *Industrial wastes, *Electrolysis, *Alternating current, *Catalysts, *Separation techniques, *Equipment.

For the purification of water supplies and for the treatment of waste waters, such as the discharges from manufacturing processes, sewage disposal plants and chemical operations, it is desirable to remove material which would otherwise be objectionable in it such as poisonous and malodorous chemicals, such as cyanides and phenolics. Other materials which are oxidizable in the waters into which the effluents are discharged, thereby creating an oxygen demand, should also be removed. A process for the removal of oxidizable contaminants from an aqueous medium comprises applying an alternating current of a frequency of 0.5 to 800 Hz to a pair of electrodes in contact with the contaminated aqueous medium, with catalyst-containing particles in the medium between the electrodes. The catalyst is an oxidation catalyst selected from the group consisting of a metal oxide of any of Groups IVa, Va, Vb and VIIB, and mixtures thereof. In preferred embodiments of the invention the catalyst-containing particles are particles in a bed which are coated with a suitable oxide such as one of manganese, chromium, bismuth or lead and they may be mixed with particles of activated carbon and/or graphite. The alternating current is at a frequency of 10 to 400 Hz, certain particle sizes of the bed packing are employed, the electrodes are of particularly described materials and preferred voltages, current densities, temperatures and pH's are utilized. (Sinha-OEIS)

W79-05957

SEWAGE TREATING AND CONVERSION PROCESS,

Nuclear Supreme, Casper, WY. (Assignee).

O. R. Waltrip.

U.S. Patent No. 4,130,483, 5 p, 3 fig, 7 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 3, p 866-867, December 19, 1978.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, *Water pollution treatment, *Filtration, *Gases, *Electric fields, *Water reuse, *Coals, *Coke, *High sulphur coal.

A high sulphur content coal is ground into particles and undergoes a coking operation in the presence of steam to form a particulate coke product and a gaseous product including sulphur dioxide and steam. The particulate coke is charged into two settling tanks to form filter beds. The aqueous sewage to be treated is introduced into one of the

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

settling tanks for passage through the filter bed where it reacts with the particulate coke both physically and chemically. A liquid effluent is withdrawn from the bottom of the settling tank while a settled solid product is periodically removed to deplete the filter bed requiring periodic recharging of the settling tank. The liquid effluent is conducted into the second settling tank for passage through the filter bed. The gaseous product from the coking operation is passed through a condenser and the condensate conducted to the second settling tank. An electric field is established in the second settling tank in order to electrically charge the particulate coke bed. As a result of the foregoing conditions within the second filter tank, the filter bed is operative to remove from the liquid effluent nitrates, phosphates and other such pollutants as well as bacterial contaminants. A liquid product in the form of potable water is extracted from the bottom of the second settling tank, suitable for irrigation purposes. (Sinha-OEIS) W79-05962

WASTEWATER TREATMENT,
Autotrol Corp., Milwaukee, WI. (Assignee).
W. N. Torpey.
U.S. Patent No. 4,130,482, 7 p., 4 fig., 1 tab., 2 ref.; Official Gazette of the United States Patent Office, Vol. 977, No. 3, p. 866, December 19, 1978.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Biological treatment, Water purification, Oxygen, Biochemical oxygen demand, Equipment.

A method for the treatment of wastewater utilizes partially submerged rotatable biological contactors to effect the removal of an optimum amount of carbonaceous matter per unit area of surface provided in the form of biological contactors. An oxygen enriched gaseous atmosphere is provided above the wastewater in the treatment unit and the unit is supplied at a filtrate BOD5 loading rate within a specific range. The wastewater treatment system includes at least two and preferably three or four stages in series. Each stage includes a well or trough through which a single rotatable shaft extends in a direction generally transverse to the direction of wastewater flow through the well. Each rotatable shaft supports a number of contactors, spaced along its length. (Sinha-OEIS) W79-05963

5E. Ultimate Disposal Of Wastes

TOUGH ENVIRONMENTAL REQUIREMENTS DEMAND NEW APPROACHES TO LANDFILL,
Residuals Management Technology Inc., Madison, WI.
J. J. Reinhardt, and D. F. Kolberg.
Pulp and Paper, Vol. 52, No. 11, p. 128-133, October, 1978, 5 fig., 8 ref., 3 tab.

Descriptors: *Pulp wastes, *Landfills, *Waste disposal, Pulp and paper industry, Wastes, Solid wastes, Bark, Fly ash, Municipal wastes, Wood wastes, Disposal, Ultimate disposal, Leachate, Odor, Leaching, Wisconsin, Clays, Sands, Dikes, Design, Surface waters, Groundwater, Water quality control, Wetlands, Flood plains, Geologic formations, Water pollution sources, Water pollution control.

Leachate chemical analyses at landfill sites are tabulated for a primary sludge from a rag pulp mill, for secondary and combined primary/secondary sludges from a joint waste water treatment plant and from a semichemical pulp mill, for a deinking sludge, and for a pretreatment sludge from a paper-coating operation. The data illustrates the wide variability among pulp and paper mill sludges. Codisposal of sludge with other wastes (e.g., bark, fly ash, wood fines, or municipal refuse) introduces problems, such as windblown fly ash, odors from bark, and increased leachate generation. The design concepts of new landfill facilities in Wisconsin, e.g., sites with clay cutoff walls and interior leachate collection systems,

sludge-lined sites, natural clay or sand sites, and diked ponds, protect ground and surface water quality, prevent the destruction or loss of wetland and/or floodplain areas, and are compatible with both waste characteristics and the geological site settings. (Swichtenberg-IPC) W79-05505

SLUDGE-DEWATERING TECHNIQUES MUST MEET POLLUTION CONTROL REQUIREMENTS,
Jordan Co. Inc., Portland, ME.
J. S. Atwell.

Pulp and Paper, Vol. 52, No. 11, p. 180-182, October, 1978, 6 fig.

Descriptors: *Pulp and paper industry, *Sludge treatment, *Dewatering, Waste treatment, Water pollution sources, Wastes, Solid waste, Water pollution control, Filters, Pulp wastes, Centrifugation, Sludge, Environmental effects, Land, Disposal, Economics, Incineration.

During the 1960s and 1970s, the pulp and paper industry made impressive strides in the development of waste management systems to improve water quality. A direct result of the operation of this treatment has been the generation of large quantities of effluent solids (sludge). Alternative sludge-dewatering systems are described, including the vacuum filter, centrifuge, horizontal-belt filter, and filter press. It is generally necessary to evaluate sludge-dewatering alternatives for each case separately, but dewatering beyond 20% is becoming more common. Increased dewatering becomes more attractive when consideration is given to environmental problems related to land disposal and the improved economic benefits of an incineration system. (Swichtenberg-IPC) W79-05506

EVALUATION OF PROPOSED TG AND E (TUCSON GAS AND ELECTRIC COMPANY) WASTEWATER DISCHARGE ON GROUNDWATER IN THE TUCSON BASIN,
Ground-Water Quality Consultant, Fresno, CA.
K. D. Schmidt.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 058, Price codes: A04 in paper copy, A01 in microfiche. November 30, 1977. 73 p., 2 fig., 10 tab., 15 ref.

Descriptors: *Arizona, *Cooling towers, *Waste water disposal, *Powerplants, Groundwater, Water pollution, Infiltration, Groundwater recharge, Fluorides, Dissolved solids, Salinity, Sulfates, Hardness(Water), Wells, Pumping, Underground waste disposal, *Environmental impact, *Tucson(AZ), *Santa Cruz River, *Tucson Gas & Electric(AZ), Cooling tower blowdown wastewater.

The purpose of this investigation was to evaluate the probable impact of a proposed discharge of cooling tower blowdown wastewater on groundwater in the Tucson Basin. The source of the wastewater is the Tucson Gas and Electric Company. About 740,000 gallons per day of wastewater are proposed to be discharged into an unnamed arroyo which eventually flows into the Santa Cruz River. Groundwater near the proposed discharge site is used primarily for industrial (cooling water) and domestic purposes. The chemical quality of groundwater in the potentially impacted area is excellent for domestic, industrial, and irrigation use except for high hardness and occasionally high fluoride contents. The impact of the proposed discharge on groundwater quality is highly dependent on the infiltration rate of wastewater in both Julian Wash and the Santa Cruz River. The discharge of 742,000 gallons per day of such wastewater at a total dissolved solids content of 500 mg/l would have little or no measurable impact on groundwater quality in the Tucson Basin. A discharge of wastewater with 1000 mg/l TDS could have some impact, while wastewater with 2500 mg/l TDS could have a significant impact on the quality of water pumped from some wells. (Visocky-ISWS) W79-05519

DISPOSAL OF SALINE WATER CONVERSION BRINES - AN ORIENTATION STUDY,
Louis Koenig - Research, San Antonio, TX.
For primary bibliographic entry see Field 3A. W79-05657

SEWAGE OSMOSIS SYSTEM,
Sewage Osmosis Inc., Minneapolis, MN. (Assignee).
For primary bibliographic entry see Field 5D. W79-05950

5F. Water Treatment and Quality Alteration

WATER QUALITY IMPROVEMENTS FROM UPGRADED WASTE TREATMENT,
Virginia State Water Control Board, Richmond.
For primary bibliographic entry see Field 5D. W79-05903

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART I. SUMMARY,
Battelle Pacific Northwest Lab., Richland, WA.
For primary bibliographic entry see Field 5C. W79-05728

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART 2. MODEL FORMULATION, CALIBRATION AND VERIFICATION,
Battelle Pacific Northwest Lab., Richland, WA.
For primary bibliographic entry see Field 5C. W79-05729

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART 3. USER'S MANUAL,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C. W79-05730

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART 4. MT. BOLD RESERVOIR DATA ACQUISITION AND EVALUATION,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C. W79-05731

INFLUENCE OF NON-POINT POLLUTION SOURCES IN CONNECTION WITH THE TUY RIVER BASIN SANITATION STUDIES,
Universidad Central de Venezuela, Caracas.
For primary bibliographic entry see Field 5A. W79-05740

PROCESS FOR PROTECTING ASBESTOS-CEMENT BEARING SURFACES IN RECIRCULATING COOLING WATER SYSTEMS,
Betz Labs., Inc., Trevose, PA. (Assignee).
For primary bibliographic entry see Field 8F. W79-05949

PROCESS AND APPARATUS FOR REMOVAL OF CONTAMINANTS FROM WATER,
Westinghouse Electric Corp., Pittsburgh, PA. (Assignee).
For primary bibliographic entry see Field 5D. W79-05957

5G. Water Quality Control

LAND AND WATER USE IN SAUDI ARABIA,
Technische Univ., Brunswick (Germany, F.R.).
Z. Hussain.
World Crops, Vol. 30, No. 2, p. 58-61, March/April, 1978, 8 fig., 6 ref.

Water Quality Control—Group 5G

Descriptors: *Drainage engineering, *Irrigation water, *Saline water, *Saudi Arabia, *Surface drainage, *Water management(Applied), Comprehensive planning, Optimum development plans, Cultivated lands, Crop production, Impoundments.

Because of the loss of one-third of the arable land in the great Al-Hassa oasis in eastern Saudi Arabia due to increasing soil salinity, the Al-Hassa Irrigation and Drainage Authority (HIDA) was created in the late 1960s to oversee construction of drainage ditches and concrete-lined irrigation canals to route the water from 32 springs (of a total of 162) into a single irrigation system. Storage of saline runoff is provided in evaporation lakes. The project is being monitored to determine reclamation results so that additional springs may eventually be brought into the system when water rights have been settled. To maximize the use of water for suitable crops is a main objective of research undertaken, at the site, for soil and water analysis and re-use of drainage water where water, soil salinity, and crop type permit. Efforts are also being made to provide better management practices through extension services to farmers, since many of the present problems that reduced the arable acreage originally are due to over-irrigation and general mismanagement. In addition to limited water supplies, water quality for agricultural use is poor except for selected crops. Nevertheless, the Government's view is that the area's potential is very good under proper management. (Paylore-Arizona)

W79-05561

STORM WATER MANAGEMENT FOR LITTLE LEHIGH AND CEDAR CREEK DRAINAGE BASINS,

Lehigh Univ., Bethlehem, PA.
For primary bibliographic entry see Field 4A.
W79-05721

ACCOMPLISHMENT PLAN, REGION VIII, RED RIVER OF THE NORTH BASIN.
Environmental Protection Agency, Denver, CO. Region VIII.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-255 283. Price codes: A02 in paper copy, A01 in microfiche. Report March 1972. 23 p, append.

Descriptors: *Water quality, *Waste water, *Industrial wastes, *Water pollution, *Red River of the North Basin(MN), Nutrients, Dissolved oxygen, Biochemical oxygen demand, Total suspended solids, Regional planning, North Dakota, Minnesota.

The Red River of the North Basin has been selected by EPA Region VIII as a high priority area for a pollution prevention abatement and control program for fiscal years 1972, 1973, and 1974. Recreational use of the River has been limited because of municipal, industrial and agricultural discharges. This accomplishment plan discusses specific tasks and plans for accomplishing the water quality objectives for the area, including: improvement of the bacteriological and dissolved oxygen quality of the Red River; reduction of wastewater flows and concentrations through implementation of the permit program; analysis of nutrient problem and development of a control program; mitigation or prevention of adverse effects on water quality from diversion and use of Garrison project waters; and supplementation of comprehensive, basin-wide water quality management plans for the Red River Basin. For each of these tasks, the report describes the purpose of the objective, its situation, the approach used by planners, milestones in attaining the objective, interrelationships with other objectives and programs, and the unresolved policy issues and problems of the objectives. Also included are charts listing the milestones and date on which these were achieved for each objective. (Coan-NC)

W79-05722

URBAN STORMWATER MANAGEMENT AND TECHNOLOGY: UPDATE AND USER'S GUIDE,

Metcalf and Eddy, Inc., Palo Alto, CA.
J. A. Lager, W. G. Smith, W. G. Lynard, R. M. Finn, and E. J. Finnemore.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 654. Price codes: A15 in paper copy, A01 in microfiche. Report EPA-600/8-77-014, September 1977. 312 p, 61 fig, 124 tab, 248 ref.

Descriptors: *Runoff, *Urban runoff, *Storm water, *Storm drains, *Waste treatment, *Combined sewers, *Water quality, *Storm sewers, *Mathematical models, *Wastewater, *Urban stormwater management, *Water quality management(Applied), *Best Management Practices(BMP), Water pollution, Sewage, Cost analysis, Water pollution effects, Planning, Drainage, Pollution abatement, Drainage systems.

The original study assessed the state-of-the-art in ongoing urban stormwater projects. This report's purpose is to improve and accelerate the transfer of new urban stormwater technology into the field. The study consists of five parts: the approach methodology, which details the planning tools available in urban stormwater management, Data Base and Normalization, which updates field approaches now being used; Best Management Practices (BMP) for Nonstructural Stormwater Control, which summarizes the cost effectiveness finding of available nonstructural measures; Unit Processes, which updates usable processes in the various unit portions of an urban stormwater system; and System Applications, which encourages use of the total systems approach to dealing with and refining urban stormwater systems. General conclusions are that there is greater need for quantification of runoff from various pollution sources in all five of these areas. Recommendations call for targeting more research and development funds to beneficial reuse programs, researching renovated river systems, study of potential benefits of sludge by-products of stormwater treatment, studying feasibility of pretreating and storing runoff for subsequent reuse in system flushing, more consideration of the role of wetlands and streams as self purifiers of stormwater pollutants, a regional/national data storage system for stormwater management programs, and more frequent reporting of data from funded demonstration projects. (See also W75-07692) (Arnold-NC)

W79-05725

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART I. SUMMARY,

Battelle Pacific Northwest Lab., Richland, WA.
For primary bibliographic entry see Field 5C.
W79-05728

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART 2. MODEL FORMULATION, CALIBRATION AND VERIFICATION,

Battelle Pacific Northwest Lab., Richland, WA.
For primary bibliographic entry see Field 5C.
W79-05729

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART 3. USER'S MANUAL,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C.
W79-05730

WATER QUALITY MODELS FOR MUNICIPAL WATER SUPPLY RESERVOIRS, PART 4. MT. BOLD RESERVOIR DATA ACQUISITION AND EVALUATION,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C.
W79-05731

A PHOSPHORUS BUDGET FOR LAKE BURLEY GRIFFIN AND MANAGEMENT IMPLICATIONS FOR URBAN LAKES,

For primary bibliographic entry see Field 5C.

W79-05734

NONPOINT SOURCE CONTROL GUIDANCE, AGRICULTURAL ACTIVITIES,

Environmental Protection Agency, Washington, DC. Water Planning Div.
R. E. Thomson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 845. Price codes: A07 in paper copy, A01 in microfiche. EPA-440/3-78-001, February, 1978. 147 p, 40 fig, 8 tab, 101 ref, 3 append.

Descriptors: Water pollution, Water pollution control, Water quality, Water quality control, Water pollution sources, Sediment discharge, Agricultural chemicals, Salinity, Grazing, Waste disposal.

This publication presents technical and management guidance information regarding problem identification and assessment, information needs and analyses, and best management practices (BMP's) to provide state and areawide water quality management agencies and other concerned groups with assistance in the development and implementation of programs to control nonpoint sources of pollution. (Skogerboe-Colorado State)

W79-05811

DISPOSAL OF A LARGE QUANTITY OF SODIUM FLUOROACETATE IN A SANITARY LANDFILL SITE LOCATED IN AN AQUIFER RECHARGING AREA,

Jefferson County Health Department, Lakewood, CO.; and Colorado Univ., Denver. School of Medicine.

C. J. Johnson.

Available from the National Technical Information Service, Springfield, VA 22161 as HRP-0007056. Price codes: A02 in paper copy, A01 in microfiche. Report HRP-0007056, November 1975. 6 p, 8 ref.

Descriptors: *Landfills, *Toxins, *Groundwater recharge, *Colorado, Waste disposal, Hazards, Poisons, Land use, Geology, Natural recharge, Leaching, Public health, Water wells, Water quality, Water pollution, Water pollution sources, Pollutants, Path of pollutants, Sodium fluoroacetate.

This report was a case history illustrating the need for suitable precaution in handling large amounts of very toxic and hazardous materials. The safe disposal of very large amounts of hazardous substances presents special problems. In this case, no one involved realized that a potentially serious situation was being created inadvertently. It is very probable that similar situations are occurring elsewhere without notice. On November 6, 1974, the author was informed that 6,000 pounds of material described as 'ineffective rat bait' had been buried at a sanitary landfill site. The bait was considered ineffective because the grain had become too old to be palatable to rats. The agent in the bait, 1080 or Sodium Monofluoroacetate (MFA), was thought to be as fully potent as when manufactured. The sanitary landfill did not appear to be the proper site for disposal of such a large amount of such a highly toxic and soluble toxin. A check of drainage maps of the area disclosed that an intermittent stream ran by the disposal site and within a mile downstream there were 8 homes on wells near the stream. The stream continued then for some distance, draining into a reservoir for a large water district. The material was removed and arrangements were made for storage. Subsequent meetings with State officials resulted in the decision that the material should be encapsulated before burial. This incident illustrates the need for better guidelines concerning the disposal of hazardous substances. (Sims-ISWS)

W79-05835

WATER TREATMENT,

Laporte Industries Ltd., London (England). (Assignee).

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

For primary bibliographic entry see Field 5D.
W79-05948

APPARATUS FOR REMOVING RAINBOWS FROM FLOWING WATER,

G. A. Black.

U.S. Patent No. 4,130,489, 3 p, 8 fig, 11 ref; Official Gazette of the United States Patent Office, Vol. 977, No. 3, p 868-869, December 19, 1978.

Descriptors: *Patents, *Oil pollution, *Water pollution treatment, *Water purification, *Water quality control, Absorption, Running waters, Thin films, Separation techniques, Oil slicks, Bilge water.

An apparatus removes from the surface of water oil contamination particularly in the form of very thin films known as 'rainbows'. It comprises purifying stages each containing small independent free-floating pads of buoyant material preferentially absorbent of oil in the presence of water. The contaminated water is passed through the purifying stages in succession. Two embodiments are shown, one adapted for use to purify the surfaces of bodies of running water such as streams or canals, and one for use in purifying effluents such as bilge water of vessels being pumped from them. (Sinha-OEIS)

W79-05961

NORTH CAROLINA 208 CASE STUDY,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.

For primary bibliographic entry see Field 6E.

W79-05969

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

APPLICATION OF HYDRAULIC AND HYDROLOGIC DATA IN URBAN STORMWATER MANAGEMENT,

Geological Survey, Oklahoma City, OK. Water Resources Div.

T. L. Huntzinger.

Geological Survey open-file report 78-414, October 1978. 33 p, 24 fig, 4 tab, 4 ref.

Descriptors: *Floods, *Urban hydrology, *Flood control, *Flood forecasting, *Analytical techniques, Flood plains, Storm runoff, Flood profiles, Rating curves, Step-backwater computations.

Techniques are described for using flood-insurance study information from the Federal Insurance Administration to analyze flood plain management alternatives. A method of developing rating curves which relate flood discharge to flood elevation is explained. Graphical methods of determining urban flood discharges are used in conjunction with rating curves to develop flood profiles resulting from future urban development. The graphical techniques were compared with standard step-backwater computations for two storms and errors were less than 0.5 foot, which are well within acceptable limits. (Woodard-USGS)

W79-05588

A DEMONSTRATION OF AREA WIDE WATER RESOURCES PLANNING,

Metropolitan Washington Council of Governments, Washington, DC.

C. S. Spooner, J. Promise, and P. H. Graham.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 750, Price codes: A10 in paper copy, A01 in microfiche. Report EPA-600/5-78-0062, April 1978. 184 p, 31 fig, 138 ref, 4 append. 802149. EPA 16110 FE9 and S-802149.

Descriptors: *Water resources planning, *Water quality, *Waste water treatment, *Resource allocation, *Computer model, *Water resources manage-

ment, *Framework model, *Land use planning, *Washington DC Metropolitan Area, Social impacts, *Water runoff, Cost-benefit analyses, Environmental effects, 208 Area-wide Planning, Potomac Estuary Model, Models, Water supply, Water pollution sources, Simulation, Storm runoff, Impact analysis.

This study was undertaken to meet four basic objectives: to develop a comprehensive water resources planning model for the metropolitan Washington Council of Governments (MWCOC) area, especially to evaluate the effects of physical growth on present water resources; to select an appropriate computer model (a) capable of simulating key components of the area's water resource system; to identify water quality management options available to the MWCOC; and to test the effectiveness of an accepted water resources planning model by evaluating the cost effectiveness of six alternative areawide water resources management strategies. Findings concluded that the MWCOC model is a versatile and sophisticated tool, capable of analyzing the areawide water resources program and the fiscal, environmental, and social impacts of the areawide strategies emanating from the model; and that the model can be used satisfactorily to meet the standards as provided in Section 208 of the Federal Water Pollution Control Amendments of 1972. Physical simulation elements of the Framework Model were refined and improved, including community development, water demand, sewage generation, stormwater runoff, waste treatment management, and receiving water components. Also refined were the model's impact analysis elements: water quality, objectives, natural resources impact, cost, financial arrangements, social impact, and implementability. (See also W79-05715) (Arnold-NC)

W79-05714

A DEMONSTRATION OF AREAWIDE WATER RESOURCES PLANNING—USERS MANUAL,

Metropolitan Washington Council of Governments, Washington, DC.

C. S. Spooner, J. Promise, and P. H. Graham.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-286 205, Price codes: A10 in paper copy, A01 in microfiche. Report EPA-600/5-78-0066, April 1978. 195 p, 23 fig, 10 tab, 32 ref, 4 append. 68-01-3704.

Descriptors: *Water resources planning, *Computer models, *Washington, DC. Metropolitan Area, *Potomac Estuary model, *Framework model, *Water resources management, Systems analysis, Land use planning, Water supply, Data collection, Social aspects, Environmental effects, Resource allocation, Areawide waste treatment management, Water pollution sources, Models, Impact analysis, Wastewater treatment, Simulation, Storm runoff.

This manual was written to be used in conjunction with the main report, which analyzed and recommended refinements to the water resources planning model used by the Metropolitan Washington Council of Governments (MWCOC). Twelve computer model components are described for use as a general guide to developing an individual water resource planning model for other areas. Model components (with program names in parentheses) include empiric activity allocation (EMPIRIC), interfacing of community development alternatives model with the water demand model (INTERFACE 4), estimation and forecasting of municipal water requirements (MAIN 11), adaptation of MAIN 11 data into programs for municipal water use and sewage flows (FIXSEWER), municipal water use (MUNWATER), sewage flows (SEWAGE), conversion of EMPIRIC data to a more useable form (EMPDMA), preparation of data for Stormwater Management Model (PRES-TORM), stormwater data (STORMWATER MODEL), determination of stormwater flow from natural watershed drainage (SPLIT), simulation of alternative wastewater treatment management option (TREATMENT), and a modeling of the hydraulics and quality constituents of the Potomac Estuary during storm and dry conditions (POTOMAC ESTUARY MODEL). (See also W79-05714) (Arnold-NC)

W79-05715

STORM WATER MANAGEMENT FOR LITTLE LEHIGH AND CEDAR CREEK DRAINAGE BASINS,

Lehigh Univ., Bethlehem, PA.

For primary bibliographic entry see Field 4A.

W79-05721

URBAN STORMWATER MANAGEMENT AND TECHNOLOGY: UPDATE AND USER'S GUIDE,

Metcalfe and Eddy, Inc., Palo Alto, CA.

For primary bibliographic entry see Field 5G.

W79-05725

ECONOMICS OF WATER DEVELOPMENT IN LESS DEVELOPED COUNTRIES,

For primary bibliographic entry see Field 6B.

W79-05750

HYDROGEOLOGY AND COMPUTER MODEL OF THE BASS LAKE AREA, ST. CROIX COUNTY, WISCONSIN,

Department of Geology and Geophysics, University of Wisconsin-Madison.

For primary bibliographic entry see Field 2H.

W79-05795

A PRINT-PLOT DISPLAY SYSTEM FOR A LINEAR PROGRAMMING-BASED RESOURCES PLANNING MODEL,

Water Resources Research Center, University of Hawaii, Honolulu, Hawaii.

T. Liang, and P.-S. Leung.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 418, Price codes: A04 in paper copy, A01 in microfiche. Technical Memorandum Report No. 59, November 1978. 51 p, 17 fig, 1 tab, 2 append. OWRT B-053-HI(1). 14-34-0001-8013.

Descriptors: *Planning, *Model studies, Data display, Data transmission.

Many resource planning models have been developed, but few have been implemented. Frequently, months are needed to prepare inputs for a few seconds of analysis. The analysis output again requires weeks of plotting for easy comprehension. Although analysis time has been reduced drastically, preparation of inputs and display of outputs have become bottlenecks to the acceptance of most resource models. Planning is usually an iterative process. Original inputs must be frequently referenced to generate new planning actions. For example, transferring of water from wet to dry areas requires study of existing water supply conditions spatially. Creating an efficient input data basis for fast retrieval and display will speed up the planning process. The iterative process generates a large volume of output which must be quickly displayed, a fact which requires a fast display system. A print-plot display system for both inputs and outputs was developed to improve the planning process based on the resource model developed earlier by Liang (1976, 1978).

W79-05797

FEASIBILITY STUDY FOR DEVELOPMENT OF A TRANSIENT THREE-DIMENSIONAL GROUNDWATER FLOW MODEL UTILIZING THE FINITE ELEMENT METHOD,

Maryland Univ., College Park. Water Resources Research Center.

For primary bibliographic entry see Field 2F.

W79-05799

SUBSURFACE DRAINAGE MODEL WITH ASSOCIATED SEDIMENT TRANSPORT,

Florida Univ., Gainesville.

For primary bibliographic entry see Field 2J.

W79-05802

Evaluation Process—Group 6B

APPLICATIONS OF REMOTE SENSING TO WATER RESOURCES.
ECOsystems International, Inc., Gambrills, MD.
For primary bibliographic entry see Field 7B.
W79-05840

FLOOD-PLAIN DELINEATION FOR OCCOQUAN RIVER, WOLF RUN, SANDY RUN, ELK HORN RUN, GILES RUN, KANES CREEK, RACCOON CREEK, AND THOMPSON CREEK, FAIRFAX COUNTY, VIRGINIA.
Geological Survey, Richmond, VA. Water Resources Div.
P. L. Soule.
Geological Survey open-file report 79-215, 1978.
118 p., 86 fig., 8 tab., 4 ref.

Descriptors: *Flood forecasting, *Flood recurrence interval, *Flood profiles, *Flood plains, *Analytical techniques, Flood frequency, Land use, Urbanization, Topography, Virginia, *Fairfax County, *Flood boundary maps, Occoquan River, Wolf Run, Sandy Run, Elk Horn Run, Giles Run, Kaners Creek, Raccoon Creek, Thompson Creek.

Water-surface profiles of the 25-, 50-, and 100-year recurrence interval discharges have been computed for all streams and reaches of channels in Fairfax County, Virginia, having a drainage area greater than 1 square mile except for Dogue Creek, Little Hunting Creek, and that portion of Cameron Run above Lake Barcroft. Maps having a 2-foot contour interval and a horizontal scale of 1 inch equals 100 feet were used for base on which flood boundaries were delineated for 25-, 50-, and 100-year floods to be expected in each basin under ultimate development conditions. This report is one of a series and presents a discussion of techniques employed in computing discharges and profiles as well as the flood profiles and maps on which flood boundaries have been delineated for the Occoquan River and its tributaries within Fairfax County and those streams on Mason Neck within Fairfax County tributary to the Potomac River. (Woodard-USGS)
W79-05986

MATHEMATICAL MODELS AND BORDER IRRIGATION DESIGN.
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 3F.
W79-05991

6B. Evaluation Process

TRADITIONAL PERCEPTIBILITIES (SIC.) OF ENVIRONMENT AND DESERTIFICATION: A CASE STUDY.
Central Arid Zone Research Inst. Jodhpur (India).
S. P. Malhotra.
Economic Geography, Vol. 53, No. 4, p. 347-352, Oct. 1977. 2 tab., 4 ref.

Descriptors: *Desertification, *Environmental effects, *India, *Environmental engineering, *Land management, *Comprehensive planning, Rainfall, Winds, Soil analysis, Land use, Exploitation, Social aspects, Water management(Applied), Arid lands, Human population, Marginal productivity, Biodegradation, Reforestation, Optimum development plans, Non-structural alternatives.

The Luni Panchayat Samati community Development Block, located in the district of Jodhpur, India, is the subject of this case study to illustrate the traditional causes and necessary remedies of increasing desertification in this water-stressed arid region. Environmental stresses, general land conditions, rainfall, wind direction, flora and fauna, agricultural changes and famine periods within the 2000 square kilometers of the development block, indicate that increasingly harsh climatic factors as well as the dual increase in population and its need have been the principal factors causing and perpetuating desertic conditions. Soil impoverishment and lower productivity are the results of excessive biotic interference, improper land use, increasing

cultivation of marginal lands, and over exploitation of woody biomass. Foremost among needed remedies to this situation are population control, education, and non-agricultural vocation development. It is evident from this case study that proper management techniques must include the conversion of marginal lands into pasture, an emphasis upon quality livestock over quantity, and the development of alternative sources of fuel to curb the indiscriminate cutting of trees and shrubs. (Tickes-Arizona)
W79-05562

THE RELATIONSHIP BETWEEN ECONOMIC DEVELOPMENT AND ECOLOGICAL DEGRADATION: HOW DEGRADATION HAS OCCURRED IN WEST AFRICA AND HOW ITS PROGRESS MIGHT BE HALTED.
London School of Hygiene and Tropical Medicine (England). Dept. of Medical Protozoology.
W. E. Ormerod.
Journal of Arid Environments, Vol. 1, No. 4, p. 357-379, Dec. 1978 3 tab., 4 fig., 57 ref.

Descriptors: *Economic justification, *Droughts, *Soil erosion, *Rainfall intensity, *Seasonal, *Biodegradation, Planning, Alternative planning, Productivity, Economic feasibility, Exports, Agroclimatology, Grazing, Land use, Carrying capacity, Forest conservation, Projections, Arid lands, West Africa, Water management(Applied).

The purpose of this paper is to illustrate through recent events in West Africa, that economic development and agricultural exploitation in arid regions have been primary causes for the creation of deserts. Stimulated by increased economic demand, the growth of both herds and arable farming for short-term benefits from cash-export crops, are causing intense competition for land in the range areas of West Africa. The major factors which emerge as principal causes of physical deterioration of rangeland in the arid Sahelian and Sudan regions are tropical rainfall highly concentrated in a short time period, high temperatures, drought, and the decrease of soil fertility when subjected to overgrazing and other excessive land uses. The resulting degradation has significantly affected the climatology of the area and increased desiccation at the fringes of these desert regions. Emphasized in the search for possible solutions to these problems is the need to develop quantitative techniques to assist agricultural planners with improved water management, and assess the overall capacity of these areas in relation to the demand for food and economic growth. Development plans must be made in the context of preventing further soil degradation, wasteful water use, or climatic change. Possible strategies of disease control, forest conservation, and food production are suggested here to achieve these ends. (Tickes-Arizona)
W79-05565

THE CAP - WHO NEEDS IT.
Arizona Society of Professional Engineers Phoenix.
F. Welsh.
Arizona Professional Engineer, Vol. 30, No. 7, p. 7 and 21, July, 1978. 1 fig.

Descriptors: *Arizona, *Economic feasibility, *Cost-benefit analysis, Central Arizona Project, Water resources development, Groundwater availability, Forecasting, Economic impact, Political aspects, Planning, Project post-evaluation, Water management(Applied), Economic justification, Area redevelopment.

This analysis questions the value of the Central Arizona Project (CAP) by attempting to show that while utilizing massive amounts of energy and tax dollars, the project does little to solve the needs of modern Arizona. Projections by the Arizona Water Commission and the U.S. Geological Survey indicate that groundwater reserves are sufficient to supply both Tucson and Phoenix for at least 100 more years and that population projections for the year 2034 of 5.5 million is only half of what can be supported with present water supplies.

Agricultural use of CAP water also does little to justify the project as agriculture already consumes 89% of our water, returns only about 5% to our personal income, consumes 9% of the nation's natural resources, and provides only 1% of America's crop production. Citing economic data provided by University of Arizona and University of Montana economists, this author illustrates how a negative benefit/cost ratio is the result of the projection that CAP water would rescue only 0.07% of our personal income. Questioning the judgment of State and Federal administrators, it is contended here that the best course of action would have been to develop existing land and water projects further rather than to initiate this costly and largely inefficient program. (Tickes-Arizona)
W79-05568

SYNTHESIS AND CALIBRATION OF A RIVER BASIN WATER MANAGEMENT MODEL.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. M. Shafer, and J. W. Labadie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 850. Price codes: A05 in paper copy, A01 in microfiche. Environmental Resources Center, Colorado State University Completion Report No. 89. October 1978. 68 p., 15 fig., 14 tab., 19 ref. OWRP A-039-COLO(1).

Descriptors: *Simulation, *Water supply, *River basins, *Network analysis, Interbasin water transfers, Streamflow, Reservoir storage, Water conveyance, Diversion, Computer models.

A computer model is presented for the analysis of large scale water resources policy changes. The model is designed to aid in the investigation of the impact of volumetric transfers of water, on a monthly basis, throughout a system of interconnected storage and demand centers. The model is capable of considering the ordered preference of demand satisfaction versus storage retention throughout the network. An interactive, conversational data management program has also been interfaced with the model to facilitate the rapid analysis of varying management alternatives. The case study approach is used to present the model and demonstrate its application. The Cache la Poudre River Basin in north-central Colorado is modeled to determine the availability of a firm water supply for the proposed Rawhide Project. By contract, this firm water supply must be composed of reusable foreign water diverted and first used by the City of Fort Collins, Colorado. A detailed model calibration study was undertaken and presented in its entirety. Three years of complete storage and diversion data were available from the Colorado Water Data Bank on which model calibration was based. Upon successful model calibration, two management strategies were outlined for the actual analysis of opportunities for Fort Collins to meet Rawhide Project water needs.
W79-05583

A DEMONSTRATION OF AREA WIDE WATER RESOURCES PLANNING.
Metropolitan Washington Council of Governments, Washington, DC.
For primary bibliographic entry see Field 6A.
W79-05714

A DEMONSTRATION OF AREA WIDE WATER RESOURCES PLANNING—USERS MANUAL.
Metropolitan Washington Council of Governments, Washington, DC.
For primary bibliographic entry see Field 6A.
W79-05715

EVALUATION OF PLANNING FOR FISH AND WILDLIFE, LAKE SHARPE RESERVOIR PROJECT.
Sport Fishing Inst., Washington, DC.
For primary bibliographic entry see Field 6G.
W79-05717

Group 6B—Evaluation Process

THE PERCEPTION AND VALUATION OF WATER QUALITY: A REVIEW OF RESEARCH METHOD AND FINDINGS.

Regional Science Research Inst., Philadelphia, PA. R. E. Coughlin.
Discussion Paper Series No. 80, June 1975. 43 p, 5 fig. 68-01-199.

Descriptors: *Water quality, *Social values, *Water values, *Water resources, *Attitudes, *Environmental assessments, Aesthetics, Water pollution, Bodies of water, Evaluation, Measurement, Testing procedures, Surveys, Limnology, Multiple regression, Research methods, Stream quality, *Perceptions.

The purpose is to discuss some of the methodological considerations in measuring people's perception of water quality, and to review research which has been done on this subject, thereby providing a basis for the exploration of where research and policy should go from here. Many of the effects of pollution go beyond physical health and economics and enter the realm of value systems. General problems in measuring perception include agreement and differentiation among observers concerning a particular environment, establishing a connection between perception and physical measurement of the environment and replicating measurements over time and different observers. Specific methodological problems concern replicating the experimental setting for different observers, and whether to take the observers to the sites of water pollution, or find people on or nearby the site and determine their perceptions. The report describes and cites research efforts on various aspects of the perceptions and evaluation of water quality; the physical, chemical, and biological characteristics of a water body; the perceptions which are held of these characteristics; the resulting preferences and attitudes towards the water body; and the uses to which the water body is put. The report urges two-dimensional and multi-dimensional trade-off studies to scale many of the values people assign to water quality. (Coan-NC) W79-05723

SELECTED PRIORITIES: 1978-82—A FIRST-YEAR EFFORT RECOMMENDING PRIORITIES FOR SELECTED FEDERAL WATER AND RELATED LAND RESOURCE PROGRAMS IN NEW ENGLAND.

New England River Basins Commission, Boston, MA.
For primary bibliographic entry see Field 6E. W79-05724

URBAN STORMWATER MANAGEMENT AND TECHNOLOGY: UPDATE AND USER'S GUIDE.

Metcalf and Eddy, Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5G. W79-05725

ECONOMICS OF WATER DEVELOPMENT IN LESS DEVELOPED COUNTRIES.

L. D. James.
Water Supply and Management, Vol 2, No 4, p 373-386, 1978. 24 ref.

Descriptors: *Developing countries, *Water resources development, *Economics, *Planning, *Methodology, *Research priorities, Governments, Technology, Economic feasibility, Economic efficiency, Economic development, Cost-benefit analysis, Irrigation, Water supply, Political aspects, Analytical techniques, Environmental effects, Social aspects, Social impact, Social participation.

The evolution of water resources planning in the U.S. has produced a set of principles, standards, and procedures for guiding further water development which might be adaptable to needs of developing countries. This paper describes how to accomplish such a modification of theory and practice, set down by the U.S. Water Resources Council (1977). There are five planning components: (1) project purposes, (2) planning objectives, (3) project

level, (4) feasibility tests, and (5) project design. Each component is evaluated, and several research priorities are identified: (1) upgrade feasibility study quality; (2) develop water planning objectives and a planning methodology through interaction among political leaders, professional planners, and technical experts; (3) standardize such procedures as those for determining shadow prices for estimating economic value in feasibility studies; (4) develop better procedures for estimating indirect and secondary benefits; (5) define ecological impacts of water resources development in tropical areas and socio-cultural impacts in developing countries; and (6) determine the proper mix of nonstructural and structural, individual and group water management programs for a given area to promote economic self-sufficiency in the country, and develop methods for training people to make the best use of the water resource facilities provided. (Lynch-Wisconsin) W79-05750

PERILS OF THE ORDERLY MIND: COST-BENEFIT ANALYSIS AND OTHER LOGICAL PITFALLS.

Gilbert/Commonwealth, Reading, PA. J. Ghiselin.
Environmental Management, Vol 2, No 4, p 295-300, July 1978. 48 ref.

Descriptors: *Environmental effects, *Economics, *Cost-benefit analysis, *Analytical techniques, *Theoretical analysis, *Problem identification and ranking, Federal government, Cost-benefit theory, Political constraints, Legal aspects, Regulation, Methodology, Decision-making, Planning, Judicial decisions, Quantification, Monetization, Mathematics, Resource management, Scientific method.

Several procedures in general use in environmental cost-benefit analysis are based upon serious theoretical errors, in particular the notion that all variables can be quantified, and the basic mathematical fallacy that outcomes of unrelated activities can be ranked on a single scale. An underlying theoretical mistake is application of the scientific method, usable only for decisions premised on numerical measurements or at least scalar values, to decisions which are not numerical but are based on taste or judgment, such as in music, aesthetics, or drama. Some fields, including architecture or medicine, require both scientific and artistic skill. Monetization of costs and benefits is delusive because: (1) it ignores aspects which cannot be monetized, and (2) it is inaccurate to the extent of the least precise estimate included (the weakest link principle). Environmental regulations generally recognize the impossibility of assessing all effects in quantitative terms, and instead require that all environmental effects be considered and weighed one against another where possible. Weighing of costs and benefits was formally required in a 1971 U.S. Court of Appeals decision (the Calvert Cliffs decision). This decision led to attempts to quantify innumerable findings and opinions in a multitude of fields activity areas. This paper proposes as an alternative that such decisions be placed in the hands of qualified judges who can assess differing effects (determined by experts) using whatever standards a particular evaluation may call for. (Lynch-Wisconsin) W79-05751

AN ECONOMIC ANALYSIS OF PHOSPHORUS CONTROL AND OTHER ASPECTS OF R76-1.

DePaul Univ., Chicago, IL.
For primary bibliographic entry see Field 6E. W79-05752

ECONOMIC IMPACT OF PROPOSED AMENDMENTS TO WATER POLLUTION REGULATIONS, R77-12, DOCKET A.

Harza Engineering Co., Chicago, IL.
For primary bibliographic entry see Field 6E. W79-05753

THE EFFECT OF WATER POLLUTION CONTROL REGULATIONS ON THE COST OF PRODUCTION OF ELECTRIC POWER.

Auburn Univ., AL. Water Resources Research Inst.
T. A. Deyak, and A. N. Link.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 270, Price codes: A03 in paper copy, A01 in microfiche. Bulletin 36, March 1979, 24 p, 1 fig. OWRT A-062-ALA(1).

Descriptors: Federal Water Pollution Control Act, *Electric power production, Costs, *Regulations, Utilities, Heated water.

The purpose is to examine the impact of water pollution control regulations, as outlined by the 1972 Amendment to the Federal Water Pollution Control Act, on the production process of U. S. steam-electric utilities. The major thrust of this 1972 Amendment and of the subsequent state and local pollution policies is to limit the amount of pollutants which business firms, municipalities, and consumers may discharge into the environment. Specifically, two national goals pertaining to water quality were established: (1) to eliminate the discharge of pollutants into navigable waters by the year 1985 and (2) to provide by the year 1983 a level of water quality sufficient to protect life and recreation in and on the water. Since the operation of steam-electric plants involves the disposal of large quantities of waste heat into surface waters or into the air, it has been one industry significantly affected by these legislations. This analysis finds that utilities subject to these pollution control regulations are able to adjust their production technologies to partially internalize the increased costs associated with meeting the abatement standards. However, firms subject to stringent regulations will have no choice but to pass the increase in production costs directly to the consumer if they expect to maintain their existing levels of profit. W79-05796

CLASSIFICATION OF EVALUATION OF FLOOD FLOW FREQUENCY ESTIMATION TECHNIQUES.

Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E. W79-05844

RAPIDLY OBTAINING OPTIMAL IRRIGATION SYSTEM DESIGNS.

Idaho Univ., Aberdeen.
For primary bibliographic entry see Field 3F. W79-05993

6C. Cost Allocation, Cost Sharing, Pricing/Repayment**PRICING IRRIGATION WATER IN MEXICO: EFFICIENCY, EQUITY AND REVENUE CONSIDERATIONS.**

Michigan Univ., Ann Arbor. Dept. of Resources Economics.
G. Schramm, and V. F. Gonzales.
The Annals of Regional Science, 15-35, March, 1977 3 tab, 3 fig, 35 ref.

Descriptors: *Water utilization, *Efficiencies, *Water costs, *Irrigation water, *Mexico, *Competitive prices, *Economic impact, Competing uses, Water consumption (Except consumptive use), Adjusted prices, Average prices, Equity, Water rates, Economic analysis, Fixed costs, Income, Institutional constraints, Legal aspects.

If irrigated agriculture is to be expanded in the arid regions of Mexico, where 91% of the potentially available water resources are currently exploited, greater water use efficiency must be achieved. It is these authors' contention that an effective instrument to bring about such an improvement is an appropriate water pricing structure. Accordingly, a brief view of the water problem in Mexico is followed here by discussions of the legal and con-

Water Demand—Group 6D

ceptual issues related to the pricing of water. Although economists generally agree that an efficient utilization of water resources can be brought about by the application of the principle of equi-marginal value in use, empirical findings show that Mexican irrigation farmers pay, on the average, less than 10% of the actual water costs. Results of this same study indicate water use efficiencies to be less than 50%, although this figure is markedly higher in irrigation districts with volumetric compared to fixed water charges. Based upon the need to change existing conditions, some representative pricing structures are presented designed to account for both efficiency and income distribution goals. It is pointed out, however, that the implementation of the policies presented here have formidable political, institutional and legal obstacles to overcome. (Tucson-Arizona)
W79-05566

THE CAP - WHO NEEDS IT.

Arizona Society of Professional Engineers Phoenix.

For primary bibliographic entry see Field 6B.
W79-05568

CONGESTION, POLLUTION, AND IMPURE PUBLIC GOODS.

Arizona State Univ., Tempe. Dept. of Economics. A. C. Deserpa.

Public Finance, Vol 33, No 1-2, p 68-83, 1978. 1 fig, 1 tab, 1 fig, 25 ref, 1 append.

Descriptors: *Externalities, *Economics, *Air pollution, *Public goods, *Impure public goods, *Congestion, Optimization, Model studies, Mathematical models, Waiting, Classification, Theoretical analysis.

Three general classes of congestion are defined and formally incorporated into the impure public goods model. This paper examines optimality conditions of the impure public good model under the three classes of externality. Two classes conform to the Rothenberg-Haveman distinction between congestion and pollution, while the third deals with an intermediate class typified by queuing. Congestion and pollution are distinguished by separability of the activity which begets the externality. Pollution is consumed by each inhabitant of the polluted area independently of his contribution to the pollution; pollution is thus 'purely separable' from the cause. By contrast the individual causes the congestion in proportion to his participation in the activity (such as time loss on a highway) and the individual bears the external cost at the margin, unlike the case of pollution. Waiting fits neither category, representing a set-cost which reduces each participant's economic surplus, but the extent of the wait is independent of length of participation in the activity. This type of externality is termed 'discretely separable'; waiting is inseparable from the cause, but the participant bears no cost at the margin. (Lynch-Wisconsin)
W79-05748

STANDARD SETTING AND THE THEORY OF INSTITUTIONAL CHOICE: THE CASE OF POLLUTION CONTROL.

D. J. Storey.

Policy and Politics, Vol 6, No 4, p 421-424, 1977.

Descriptors: *Water pollution control, *Economics, *Pollution taxes (Charges), *Water quality standards, *Policy, *Institutional constraints, *Political constraints, United States, United Kingdom, Costs, Marginal costs, Regulation, Information requirements, Equity, Enforcement.

Economic arguments and historical reasons explain why effluent charges have not been adopted in the United States and United Kingdom for water pollution control. This paper counters Majone's argument (1973) that political or bureaucratic self-interest is responsible for opposition to effluent charges and continued adherence to the water quality standards approach. Majone maintains that effluent charges are demonstrably superior to other poli-

cies. But this study argues that in terms of information requirements, equity, and effectiveness the standards approach equals or better the effluent charge system. Information requirements are in fact comparable for the two systems, despite claims that no costly information gathering is needed for effluent charges. Majone ignores equity; under an effluent charge system all firms are subject to the same tax, but those with lowest marginal abatement costs carry most of the burden of abatement, and since these firms may be those most likely to go out of business, local unemployment may result. The effluent tax cannot account for such complications. Majone cites the U.S. experience to show the failure of the standards approach, but data from the U.K. support the opposite conclusion. Finally, effluent taxes have been seriously considered only in recent years and by economists, for whom public esteem is not high, and engineering standards therefore have remained unchallenged. (Lynch-Wisconsin)
W79-05749

A NOTE ON THE ECONOMIC SIGNIFICANCE OF UNIFORM WATER APPLICATION.

Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 3F.
W79-05816

6D. Water Demand

SUMMARY OF THE WATER RESOURCES OF PUERTO RICO.

Geological Survey, San Juan, PR. Water Resources Div.

H. J. McCoy.

Geological Survey open-file report 78-971, October 1978. 17 p, 6 fig, 8 ref.

Descriptors: *Water resources, *Puerto Rico, *Hydrologic data, *Water quality, Surface waters, Groundwater, Hydrologic budget, Rainfall, Water utilization, Streamflow, Runoff, Evapotranspiration, Groundwater movement, Water supply, Water demand.

Puerto Rico has considerable variability in geology, hydrology, and topography. Rainfall provides an average of about 11,600 million gallons of water per day. The mountainous interior receives the most rainfall and the southwest coast the least. Surface water accounts for about 90 percent of public supplies but only about 20 percent of industry; agriculture uses about equal amounts of ground water and surface water. Of the average daily 11,600 million gallons of precipitation, about 7,240 Mgal/d is lost by evapotranspiration; about 3,620 Mgal/d by streamflow to the sea; and about 188 Mgal/d by ground-water flow to the sea. Municipal, industrial, and agricultural uses account for about 420 Mgal/d in losses. The south coast is the most stressed area in terms of water deficiency. Changes in water use and the importation of water are alternatives for increasing supplies to meet future demands. Generally the chemical composition of nearly all surface waters in Puerto Rico is about the same (Bogart, 1964, p. 86). The waters are predominantly of the calcium bicarbonate type. However, characteristic differences do occur—especially in dissolved solids and in concentration of specific ions. (Woodard-USGS)
W79-05592

APPLICATIONS OF REMOTE SENSING TO WATER RESOURCES.

ECOSystems International, Inc., Gambrills, MD.

For primary bibliographic entry see Field 7B.
W79-05840

WATER AND ENERGY IN THE WESTERN COAL LANDS.

Office of Technology Assessment, Washington, DC.

S. E. Plotkin, H. Gold, and I. L. White. Water Resources Bulletin, Vol. 15, No. 1, p 94-107, February 1979. 5 fig, 18 ref.

Descriptors: *Energy, *Colorado River, *Colorado, Coals, Water quality, Water resources, Water supply, Conservation, Water conservation, Water requirements, Agriculture, Crops, Cooling, Water law.

Problems of water quality and quantity are critical to development of the energy resources of the Western U.S. Based on a number of independent measures, the Upper Colorado River Basin is expected to experience severe water availability problems in a few decades if projected energy and agricultural development occurs. Given the impending collision between the competing interests of various water users, water resource management and conservation deserve the utmost attention. Substantial opportunities for conservation exist in energy and agricultural development. Selection of both conversion and cooling technologies and careful siting decisions can sharply reduce the water requirements of energy development. Agricultural water conservation strategies include improving irrigation and cultivation practices, removing phreatophytes, removing marginal lands from production, and changing crop patterns. In order to accomplish significant conservation, there must be changes in those aspects of water law that remove conservation incentives from the water use system. (Roberts-ISWS)
W79-05845

RECONNAISSANCE EVALUATION OF WATER RESOURCES FOR HYDRAULIC COAL MINING, CRESTED BUTTE COAL FIELD, GUNNISON COUNTY, COLORADO.

Geological Survey, Lakewood, CO. Water Resources Div.

W. M. Alley, L. J. Britton, and E. L. Boyd.

Availability: OFSS, USGS Box 25425, Den. Fed. Ctr. Denver, CO. 80225 microfiche \$3.50, paper copy \$3.75. Geological Survey open-file report 78-938, December 1978. 23 p, 6 fig, 6 tab, 20 ref.

Descriptors: *Surface water availability, *Groundwater availability, *Coal mines, *Hydraulic mining, *Water quality, Low flow, Streamflow, Water wells, Data collections, *Colorado, *Gunnison County, *Crested Butte coal field.

Available surface-water and ground-water data were compiled for the parts of the Gunnison River basin in and adjacent to the Crested Butte coal field. The data were evaluated to assess the quantity and quality of water resources in the area for use in hydraulic coal mining. Based on discharge records, surface-water supplies of most streams should be adequate to meet the demands for hydraulic mining of 1 million tons of coal per year with a recycled water system. However, on some of the smaller streams in the area, some storage of water may be required for use during low-flow periods to meet minimum-flow requirements for downstream reaches. Other potential sources of water for hydraulic coal mining include ground water from alluvium along major streams and from the Dakota and Entrada Sandstones. The surface and ground water in the study area should be of adequate quality for use in hydraulic coal mining, with the possible exception of Coal Creek which has excessive concentrations of iron, manganese, and zinc. Data are insufficient to assess the potential impact of hydraulic coal mining on downstream water quality. (Woodard-USGS)
W79-05975

WATER RESOURCES OF THE UPPER DUCK RIVER BASIN, CENTRAL TENNESSEE.

Geological Survey, Nashville, TN. Water Resources Div.

C. R. Burchett.

Tennessee Division of Water Resources, Water Resources Series No 12, 1977. 103 p, 52 fig, 11 tab, 31 ref.

Descriptors: *Groundwater resources, *Surface waters, *Water quality, *Available water, *Water supply, Hydrogeology, Aquifer characteristics, Water utilization, Water demand, Water wells, Water yield, Groundwater recharge, Streamflow,

Field 6—WATER RESOURCES PLANNING

Group 6D—Water Demand

Water analysis, Hydrologic budget, Tennessee, *Upper Duck River basin.

Cherty carbonate bedrock underlying the Highland Rim physiographic province in central Tennessee weathers in place to form 20 to 90 feet of unconsolidated material grading from clay-sized chert residuum at land surface to chert rubble at depth. This chert rubble zone and (or) solution openings within the bedrock have been named the Manchester aquifer. Test wells, selected by specific criteria, have penetrated zones that produce over 500 gallons per minute. The Manchester aquifer is separated from the Central Basin physiographic province by an impermeable, 25-foot-thick basal shale. Many springs occur along the Highland Rim escarpment above the shale. Below the shale is a series of relatively pure, dense limestones. Ground water is available to wells from solution openings within the bedrock. Bentonite beds, which underlie a large part of the Central Basin, are water-tight. Wells unaffected by the bentonites can produce 100 gallons per minute or more. The 7-day 10-year low flow of streams varies from 0 to 0.392 cubic feet per second per square mile. The largest flows are along the Highland Rim escarpment; the lowest flows are within the Highland Rim and Central Basin provinces. (Woodard-USGS) W79-05985

RECONNAISSANCE EVALUATION OF WATER RESOURCES FOR HYDRAULIC COAL MINING, GRAND HOGBACK COAL FIELD, GARFIELD AND RIO BLANCO COUNTIES, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.

W. M. Alley, L. J. Britton, and E. L. Boyd. Available from the USGS, OFSS Box 25425, Den. Fed. Ctr. Denver CO 80225 paper copy \$6.00, microfiche \$3.50. Geological Survey open-file report 78-885, November 1978. 37 p, 9 fig, 8 tab, 20 ref.

Descriptors: *Surface water availability, *Groundwater availability, *Coal mines, *Hydraulic mining, *Water quality, Low flow, Streamflow, Water wells, Data collections, *Colorado, *Garfield County, *Rio Blanco County, *Grand Hogback coal field.

Surface-water and ground-water data were compiled for the parts of the Colorado River and the White River basins in and adjacent to the Grand Hogback coal field. The data were evaluated to assess the quantity and quality of water resources available in the area for use in hydraulic coal mining. Based on discharge records, surface-water supplies of most streams should be adequate to meet the demands for hydraulic mining of 1 million tons of coal per year with a recycled water system. However, on some of the smaller streams in the area, some storage of water may be required for use during low-flow periods to meet minimum-flow requirements for downstream reaches. Other potential sources of water include Rifle Gap Reservoir, Harvey Gap Reservoir, and ground water from valley-fill deposits along major streams and rivers. The surface water and ground water should be of adequate quality for use in hydraulic mining, with the possible exceptions of suspended-sediment concentrations that periodically may be as much as 18,800 milligrams per liter in streams in the Rifle Creek drainage, and dissolved-solids concentrations greater than 20,000 milligrams per liter in some aquifers. Data are insufficient to assess the potential impact of hydraulic coal mining on downstream water quality. (Woodard-USGS) W79-05987

WATER SUPPLY POTENTIAL OF THE LAKE SALLY SYSTEM, MARQUETTE COUNTY, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.

N. G. Grannemann. Geological Survey open-file report 78-1046, December 1978. 14 p, 6 fig, 1 tab, 12 ref.

Descriptors: *Water supply, *Surface water availability, *Water storage, *Lakes, *Water shortage, Hydrologic data, Precipitation (Atmospheric), Overland flow, Inflow, Streams, Base flow, Water demand, Water distribution (Applied), Michigan, *Lake Sally, *Ely Creek, *Marquette County (Mich).

The Lake Sally system, Marquette County, Mich., consists of six lakes in the headwaters of Ely Creek. This system is the source of water for Ishpeming and several small communities in the central part of Michigan's Upper Peninsula. Precipitation and overland runoff account for 93 percent of the water supplied to the system. Below-average precipitation in 1976 and early 1977 resulted in low lake levels and cast doubt on the system's ability to meet water demands. Water supplied to the Lake Sally system is estimated to be 2.57 cubic feet per second (cfs) when precipitation is average. Use of water by Ishpeming is about 3.5 cfs. The city obtains some water from lakes outside the system when the supply from the Lake Sally system is insufficient. Results of a base-flow investigation on Ely Creek, the outlet of the Lake Sally system, indicate that ground-water flow to the system is between 0.08 and 0.17 cfs. (Woodard-USGS) W79-05988

6E. Water Law and Institutions

THE FOUNDING OF THE SALT RIVER WATER USERS ASSOCIATION,

J. H. Krenkel. Journal of the West, Vol. 17, No. 1, p 82-90, Jan. 1978. 8 fig, 51 ref.

Descriptors: *Administrative agencies, *Organizations, *Water storage, *Project post-evaluation, Arizona, Cooperatives, Institutions, History, Land reclamation, Project planning, Water policy, Water resources development, Salt River Water Users Association, Dams, Reservoirs.

The history and development of water management organizations in the Salt River Valley of Arizona are traced here from 1897 to the completion of Roosevelt Dam and the formation of the Salt River Water Users Association in 1911. The irrigation and power projects existing today on the Salt and Verde Rivers are representative results of the national reclamation policies which began at the beginning of the 20th century with the intention of recovering waste lands and putting them to beneficial use. The rapid arrival of new settlers and the erratic nature of the Salt River are the principal factors which have necessitated the existence of a water users association in the Salt River Valley for the last century. The efforts of both private and governmental associations and boards to support this organization as well as to construct reservoirs and dams are traced here to illustrate the long struggles and governmental fluctuations involved in formation of the present association and the construction of the Salt River Project. Although several people were instrumental in this endeavor, it was the efforts of President Roosevelt that initiated the reclamation movement and eventual construction of Roosevelt Dam which marked the beginnings of the present Salt River Water Users Association. (Tickes-Arizona) W79-05555

THE DARK AND BLOODY GROUND OF INDIAN WATER RIGHTS: CONFUSION ELATED TO PRINCIPLE,

California Univ., Los Angeles. Dept. of History. N. Hundley, Jr.

The Western Historical Quarterly, Vol. 9, No. 4, p 455-482, Oct. 1978. 1 fig, 48 ref.

Descriptors: *Water rights, *Indian reservations, *Water contracts, *Winters doctrine, *Legal aspects, *Water allocation (Policy), Water law, Administrative agencies, Boundary disputes, Jurisdiction, Land tenure, Water utilization, Reservation doctrine, Institutional constraints, History, Political

constraints, Regulation, Southwestern U.S., Arid lands.

Although the crisis of Indian water rights in the arid western U. S. can hardly be characterized as a new development, the question remains one of paramount importance to American Indian tribes in the area, an issue still clouded with confusion and still bitterly contested. Although much attention has been directed to this subject little progress has been achieved due principally to the ambiguity and contentiousness on almost every point of legal significance, including the theoretical basis of the water right itself. The problem is best understood by examining its historical development since its origins during the Indian wars and reservation policies of the late 19th century. Accordingly, a brief historical review of the legal battles over Indian water rights is presented here. Unfortunately most of the questions remain unanswered and the courts have in some cases created more problems than they have solved. It is argued here that this long standing confusion over the subject has taken on the character of a principle in Indian water law. Even if the situation were cleared up, it is further argued that long term related problems would persist. These include the insufficient number of Indians possessing the technical and managerial skills needed to guide reservation development, the problem created by fractionated ownership of land on many reservations and the reluctance of Congress and others to provide needed capital. (Tickes-Arizona) W79-05560

ACCOMPLISHMENT PLAN, REGION VIII. RED RIVER OF THE NORTH BASIN.

Environmental Protection Agency, Denver, CO. Region VIII.

For primary bibliographic entry see Field 5G. W79-05722

SELECTED PRIORITIES: 1978-82—A FIRST-YEAR EFFORT RECOMMENDING PRIORITIES FOR SELECTED FEDERAL WATER AND RELATED LAND RESOURCE PROGRAMS IN NEW ENGLAND.

New England River Basins Commission, Boston, MA.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-255 890, Price codes: A06 in paper copy, A01 in microfiche. Report, June 25, 1976. 105 p, 2 append.

Descriptors: *River basins, *River basin development, *Regional planning, *Water resources development, *New England, Economic development, Resource allocation, Land resources, Water resources, Feasibility studies, Soil Conservation Service, Geological survey, Budget allocations, Federal funding, Energy planning, Flood plain management, Groundwater surveys, Soil surveys, Data collection.

This report recommends priorities for federal investment in water and related land resource programs and projects in New England. The effort was limited to four categories of federal resource-related programs: (1) data collection; (2) planning-comprehensive 'Level B' river basin studies, special studies, and reconnaissance studies; (3) feasibility, site specific 'Level C' studies which lead to implementation; and (4) actions, design studies and project or program implementation. The data collection category was limited to the soil survey program conducted by the Soil Conservation Service (SCS) and the groundwater survey program conducted by the Geological Survey (GS). Maps, schedules, and budget allocations for soil and groundwater surveys are listed for each New England State. Priority candidates in the Planning category came from NERBC's four completed Level B studies, the Regional assessment, and other ongoing Commission activities, and from all cooperating state, federal, and regional agencies in New England. Ongoing and new start planning programs are listed with appropriate fiscal and timetable data. Candidates in the feasibility category were limited to the Level C types studies of the SCS and U.S. Army Corps of Engineers. In the

Ecologic Impact Of Water Development—Group 6G

Action category, priority candidates are limited to existing Level B studies involving federal funds. Appropriation legislation, the activities of all involved federal agencies and ongoing programs are described. (Coan-NC)
W79-05724

STANDARD SETTING AND THE THEORY OF INSTITUTIONAL CHOICE: THE CASE OF POLLUTION CONTROL.

For primary bibliographic entry see Field 6C.
W79-05749

AN ECONOMIC ANALYSIS OF PHOSPHORUS CONTROL AND OTHER ASPECTS OF R76-1.

DePaul Univ., Chicago, IL.
J. E. Ciecka, R. G. Fabian, D. S. Merilatt, and T. J. Murphy.
Illinois Institute for Environmental Quality, Document No 78/16, June 1978. 121 p, 5 fig, 27 tab, 33 ref, 5 append. 80.063.

Descriptors: *Phosphorus, *Water quality standards, *Illinois, *Cost-benefit analysis, *Water pollution control, *Regulation, *Eutrophication, Model studies, Vollenweider models, Trophic level, Oligotrophy, Value, Recreation demand, Willingness-to-pay, Travel time, Discount rates, Nutrient removal, Nutrients, Effluents, Lakes, Sewage treatment, Municipal wastes, Mathematical models, Nonpoint pollution, National pollution discharge elimination system.

An amendment proposed by the Illinois Environmental Protection Agency (PCB R76-1) to the Illinois water pollution control regulations would: (1) delete the general water quality standard for phosphorus of 0.05 mg/l, (2) add a new effluent standard for phosphorus of 1.0 mg/l applicable to discharges affecting lakes and reservoirs of 20 acres or longer, and (3) include administrative changes to make effluent standards compatible with the National Pollution Discharge Elimination System. This economic analysis concludes: (1) the 0.05 mg/l standard is not achievable due to widespread nonpoint pollution sources; (2) annual cost to 27 municipalities of meeting the 0.05 mg/l standard would be about \$3.2 million, compared with \$0.5-1.0 million with the 1.0 mg/l standard; (3) proposed regulations would not significantly affect agriculture, commerce and industry, or cost or availability of goods and services; (4) only one of 28 lakes examined with the Vollenweider trophic state model appears capable of achieving oligotrophic status under the proposed regulation; (5) the low probability of improving lake trophic state suggests there may be no benefits from phosphorus removal, regardless of standard; and (6) if there is lake improvement, the most tangible primary benefits will be in water-based recreation, measured by the travel cost method of demand analysis, with willingness-to-pay as a measure of net benefit. A 1% recreational use increase on nine lakes would be worth \$540,000 with secondary benefits of \$1.47 million in state output. (Lynch-Wisconsin)
W79-05752

ECONOMIC IMPACT OF PROPOSED AMENDMENTS TO WATER POLLUTION REGULATIONS, R77-12, DOCKET A.

Harza Engineering Co., Chicago, IL.
Illinois Institute for Environmental Quality, Document No 78/23, June 1978. 60 p, 2 fig, 11 tab, 12 ref, 3 append. 80.116.

Descriptors: *Illinois, *Water pollution control, *Regulation, *Water quality standards, *Sewage disposal, *Poisons, *Legislation, Toxicity, Dissolved solids, State governments, Waste treatment, Sewage treatment, Sewers, Combined sewers, Industrial wastes, Effluents, Cost-benefit analysis, Dilution ratio, Fish, Diatoms, Algae, Environmental effects, Secondary contact water, Definitions, Law enforcement.

Amendments proposed by the Illinois Environmental Protection Agency (IEPA) to certain sections of the Illinois Water Pollution Control Board

rules and regulations are described, and benefits and costs resulting from them are analyzed. Identified as Docket A of IEPA Proposal R77-12, amendments consist of definition changes, one new definition, modification of certain rules, and one new rule. They are grouped into five categories: (1) sewer and sewage definition changes, (2) combined sewer regulations changes, (3) secondary contact water quality standard changes, (4) dilution ratio definition, and (5) implementation plan changes. The major benefit of the amendments would be to clarify existing regulations and their intent, which would aid in enforcement and avoid litigations. Monetary benefits would result from elimination of variance requirements for combined sewer construction and less stringent effluent requirements due to the change in dilution ratio definition. These savings, though significant on an individual case basis, would not have secondary effects on agriculture, local government, commerce or industry, employment, or cost and availability of goods and services. Major costs would be related to control of total dissolved solids (in the form of eliminating violations) and control of toxic substances. The occasional total dissolved solids levels exceeding 1000 mg/l appear to be due to nonpoint sources, the control costs of which could not be assessed. (Lynch-Wisconsin)
W79-05753

FOURTH NATIONAL WORKSHOP ON ENTRAINMENT AND IMPINGEMENT.

For primary bibliographic entry see Field 5C.
W79-05754

IMPLEMENTATION OF SECTION 316 OF THE FEDERAL WATER POLLUTION CONTROL ACT.

Environmental Protection Agency, Washington, DC. Permit Program Div.
For primary bibliographic entry see Field 5C.
W79-05755

THE POWER PLANT REGULATORY PROGRAM: A CONGRESSIONAL DILEMMA.

Committee on Public Works and Transportation (U.S. House).
For primary bibliographic entry see Field 5C.
W79-05756

REGULATORY DEVELOPMENTS IN SECTION 316(B).

Environmental Protection Agency, Chicago, IL. Enforcement Div.
For primary bibliographic entry see Field 5C.
W79-05757

THE ROLE OF THE SCIENTIST IN THE SECTION 316 PROCESS: A LAWYER'S POINT OF VIEW.

LeBoeuf, Lamb, Leiby and MacRae, New York.
For primary bibliographic entry see Field 5C.
W79-05758

CENTER PIVOT IRRIGATION IN THE COLUMBIA BASIN OF WASHINGTON AND OREGON: DYNAMICS AND IMPLICATIONS.

Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 3F.
W79-05818

WATER AND ENERGY IN THE WESTERN COAL LANDS.

Office of Technology Assessment, Washington, DC.
For primary bibliographic entry see Field 6D.
W79-05845

NORTH CAROLINA 208 CASE STUDY.

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
L. F. Horney, F. A. Koehler, F. J. HumeniK, and L. F. Bliven.

Paper No. 78-2584, Presented at the 1978 Winter Meeting of the American Society of Agricultural Engineers, December 18-20, 1978, Chicago, Illinois, 6 p. 4 ref. ASAE, St. Joseph, Michigan.

Descriptors: Water pollution, Water quality, Water pollution control, Water quality control, Planning, Water management (Applied), Water law, Legislation, Agriculture, North Carolina.

The North Carolina approach for the development of the agricultural portion of the statewide 208 plan has been influenced by unanswered questions concerning actual water quality and relationships between agricultural practices, conservation techniques and areawide water quality. The planning organization and responsibilities, approaches and studies undertaken leading to plan recommendations were discussed. (Skogerboe-Colorado State)
W79-05969

6F. Nonstructural Alternatives

INFLUENCE OF NON-POINT POLLUTION SOURCES IN CONNECTION WITH THE TUYU RIVER BASIN SANITATION STUDIES, Universidad Central de Venezuela, Caracas.
For primary bibliographic entry see Field 5A.
W79-05740

6G. Ecologic Impact Of Water Development

EVALUATION OF PLANNING FOR FISH AND WILDLIFE, LAKE SHARPE RESERVOIR PROJECT.

Sport Fishing Inst., Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A041 097. Price codes: A05 in paper copy, A01 in microfiche. Prepared for Dept. of the Army, Office of the Chief of Engineers, Washington, DC. Oct. 1976. 70 p, 1 fig, 16 tab, 60 ref. DACW73-74-C-0040.

Descriptors: *Wildlife, *Fish, *Game birds, *Wildlife management, *Post impoundment, *Lake Sharpe Reservoir (SD), *Impoundments, *Aquatic birds, Reservoirs, South Dakota, Game management, Big Bend Dam (SD).

This study is an evaluation of the benefits and effects on fish and wildlife from the construction of the Lake Sharpe Reservoir Project on the Missouri River southeast of Pierre, S.D. The 55,800 acre lake, created by the construction of Big Bend Dam, in the middle of Crow Creek Indian Reservation was delayed by negotiations with the Crow Indians for years after project approval in 1944. After construction in 1964, studies were initiated of project impact on waterfowl, big game, upland game, and fishery resources in light of predicted data before construction, actual data occurrences after construction, and the relevance and usefulness of the inputs into the planning process itself. Findings of impact on waterfowl resources were that predictions of greater goose kills by hunters were inaccurate, that duck kills increased, while both species became more evenly distributed over the area following impoundment. Project impacts on big game such as white tailed deer, mule deer, and antelope indicated a sharp rise (more than 190%) in hunter kills from 1964 to 1973. Harvest of upland game such as pheasant dropped by one-half, while harvest of grouse increased 64%. Significant impacts on fish were an initial decline in rainbow trout due to temperature rise in the water and a decline in carp. The report recommends establishment of additional wildlife management areas adjacent to the lake in order to increase waterfowl and upland game and offset losses due to harvesting by hunters. (Arnold-NC)
W79-05717

FISHERIES ISSUES RELATED TO WATER DEVELOPMENT IN THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA, California State Dept. of Fish and Game, Stock-

Field 6—WATER RESOURCES PLANNING

Group 6G—Ecologic Impact Of Water Development

ion.

H. K. Chadwick.

In: Fourth National Workshop on Entrainment and Impingement, December 5, 1977, Chicago, Illinois, p 409-414, 1978, 3 fig, 11 ref.

Descriptors: *Environmental effects, *Engineering, *Intakes, Water demand, Entrainment, Fisheries, Estuarine fisheries, California, *Impingement.

This investigation indicates that the most effective ways to mitigate the adverse effects of water development in the Sacramento-San Joaquin estuary are to build an isolated channel to move the point of diversion from the south Delta to the Sacramento River and to release water down the Sacramento River and from the channel in amounts sufficient to provide the necessary degree of salinity repulsion. Fish screen development progress is discussed in light of a finding that entrainment of striped bass in water diversions has been responsible for population reduction. (See also W79-05754) (Chilton-ORNL)

W79-05789

GROWTH EFFECTS OF MAJOR LAND USE PROJECTS (WASTEWATER FACILITIES), VOLUME I: MODEL SPECIFICATION AND CAUSAL ANALYSIS,

Abcor, Inc., Wilmington, MA. Walden Div. P. H. Guldberg, R. B. D'Agostino, and R. D. Cunningham.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 410. Price codes: A12 in paper copy, A01 in microfiche. Report No. EPA-450/3-78-014a, March 1978, 254 p, 19 fig, 49 tab, 426 ref, 4 append. 68-02-2594.

Descriptors: *Waste water, *Treatment facilities, *Environmental impact, *Air pollution, *Land use, Models, Mathematical models, Statistical models, Least squares method, Statistical methods, Statistics, Cities, Planning, Analytical techniques.

The induced secondary growth effects of major waste water projects were examined with the goal of developing methodologies for predicting the total air pollution emissions which result from the construction and operation of major land use projects. The emissions are from residential complexes at the end of and along new sewer lines; service-oriented land uses relating to residential development, such as commercial, industrial, office, and government; and motor vehicles used as transportation between development areas. Data were collected nationwide from 40 case study waste water projects. This document is concerned with three of the four major phases of the study: (1) definition of basic concepts and initial model specification; (2) data collection; and (3) causal analysis of the land use model using path analysis. A theoretical model was developed representing the total land use in the drainage basin of a waste water collection and treatment system ten years after its construction. The causal analysis of induced land development involved the use of path analysis and two basic statistical techniques: two-stage least squares and stepwise ordinary least squares. The final models of land use development show strong statistical relationship between the variables representing nine categories of total land use and other model variables representing induced and non-induced land use growth processes. It was noted that treatment plant capacity was not found to be an important causal factor. (Davison-IPA)

W79-05866

7. RESOURCES DATA

7A. Network Design

A COMPENDIUM OF LAKE AND RESERVOIR DATA COLLECTED BY THE NATIONAL EUTROPHICATION SURVEY IN THE CENTRAL UNITED STATES.

For primary bibliographic entry see Field 5C. W79-05732

A COMPENDIUM OF LAKE AND RESERVOIR DATA COMPILED BY THE NATIONAL EUTROPHICATION SURVEY IN THE WESTERN UNITED STATES.

For primary bibliographic entry see Field 5C. W79-05733

WATER QUALITY: STREAMS AND PONDS ON SELECTED TEST AREAS ON EGLIN AIR FORCE BASE, FLORIDA,

Air Force Armament Lab., Eglin, AFB, FL. For primary bibliographic entry see Field 5C. W79-05839

CHEMICAL, PHYSICAL, BIOCHEMICAL, AND BACTERIOLOGICAL CHARACTERISTICS AT SELECTED STREAM SITES IN PUERTO RICO, 1967-77,

Geological Survey, San Juan, PR. Water Resources Div.

F. Quinones-Marquez, P. Vazquez, and R. Pena-Cortes.

Geological Survey open-file report 78-445, November 1978, 145 p, 1 fig, 1 tab, 12 ref. append.

Descriptors: *Water quality, *Water pollution sources, *Path of pollutants, *Puerto Rico, *Streams, Water analysis, Sampling, Sites, Chemical analysis, Chemical properties, Physical properties, Network design.

In 1969, the Caribbean District of the U.S. Geological Survey, in cooperation with the Commonwealth of Puerto Rico, initiated the operation of a network to monitor some parameters indicative of water-quality changes at selected stream sites. In 1974, at the request of the Environmental Quality Board of Puerto Rico, the network was modified to conform with the Environmental Protection Agency National Water Quality Surveillance System. The purpose of the present network is to monitor changes in water quality between the upstream and downstream stations. The expanded network consisted of 58 stations. During 1976, five had been discontinued. One other was added late in 1976. Most of the stations in the original network have been maintained, thus providing some degree of continuity. The monitoring stations used in this report are shown on a map and listed in a table. The results of the network operation are summarized for the period July 1976 to August 1977. (Woodard-USGS)

W79-05967

NATIONAL WATER DATA COORDINATION IN THE UNITED STATES,

Geological Survey, Reston, VA. Water Resources Div.

F. P. Kapinos, R. H. Langford, and A. I. Johnson. Hydrological Sciences Bulletin, Vol 23, No 2, p 193-202, 1978, 5 fig.

Descriptors: *Water resources, *Data collections, *Network design, *Methodology, Hydrologic data, Surface waters, Groundwater, Water quality, Planning, Evaluation, Analytical techniques, Testing procedures, Information retrieval, *Office of Water Data Coordination (OWDC), Federal agencies, Non-Federal agencies.

The Office of Water Data Coordination (OWDC), established in 1964 within the Department of the Interior's Geological Survey, is charged with lead-agency responsibility for coordinating Federal water-data collection activities, cataloging all water-data acquisition activities, and developing a national plan to acquire needed water data. A 21-volume 'Catalog of Information on Water Data' has been released and the data-collection activities of all Federal agencies are coordinated through an annually-released Federal Plan. The National Water Data Network, initially developed in 1966, has been further refined through a coordinated effort that has provided a nationally-consistent set of river-basin maps for use in water-resources planning and assessment and in organizing and disseminating water-resources information. Following recommendations set forth by Federal and non-Federal advisory committees, the OWDC embarked on a

procedure for designation of standards for water-data acquisition. The initial work, which began in 1970, resulted in publication of an interagency preliminary report. That report presently is being updated and expanded in cooperation with 25 Federal agencies and with technical standards-setting organizations and other non-Federal agencies. This activity will result in improved comparability, reliability, and usability of the data, and in improved efficiencies in generating, storing, processing, and disseminating water information. (Woodard-USGS)

W79-05971

7B. Data Acquisition

ESTIMATION OF SNOW TEMPERATURE AND MEAN CRYSTAL RADIUS FROM REMOTE MULTISPECTRAL PASSIVE MICROWAVE MEASUREMENTS,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. For primary bibliographic entry see Field 2C. W79-05518

CONCENTRATION AND SIZE OF GRAVEL IN RELATION TO NEUTRON MOISTURE AND DENSITY PROBE CALIBRATION,

International Inst. of Tropical Agriculture Ibadan (Nigeria). R. Lal.

Soil Science, Vol. 127, No. 1, p 41-50, January 1979, 4 fig, 6 tab, 22 ref.

Descriptors: *Nuclear meters, *Gravels, *Moisture content, Soil moisture, Instrumentation, Calibrations, Soil density, Soil texture, Particle size, Regression analysis, Statistical methods, Sands, Heterogeneity, Beaches, Neutron count ratio, Beach sand.

The effects of 4 gravel concentrations (0, 20, 40, and 60% by weight) and 3 gravel size fractions (4-8 mm, 8-15 mm, and 15-40 mm) on the calibration of a neutron moisture meter and density probe were investigated for a beach sand and a clayey tropical Alfisol (Oxic Paleustalf). The slope of the regression line of the calibration curve relating neutron count ratio with volumetric moisture content of gravel-free sand was statistically significantly different from that of three gravel-sand mixtures. The calibration curve of 3 gravel-sand mixtures was statistically identical. For the gravel-soil mixtures, the slope of the calibration curve generally decreased with increased gravel concentration. The statistical comparison of the regression lines for the 4-8 mm gravel size fraction indicated that the slope coefficient of the calibration curve of only 60% gravel-soil mixture was significantly lower than that of 0, 20, and 40 gravel percentages. For the 8-15 mm gravel size fraction, the slopes of the regression lines of 40 and 60% gravel-soil mixtures were similar and significantly lower than those of 0 and 20% gravel concentrations. Gravel size had no effect on the calibration curve in the gravel-sand mixtures. (Visocky-ISWS)

W79-05530

EASTERN-WESTERN ARCTIC SEA ICE ANALYSES,

Fleet Weather Facility, Suitland, MD. For primary bibliographic entry see Field 2C. W79-05613

LAKE ERIE ICE: WINTER 1975-76,

National Oceanic and Atmospheric Administration, Rockville, MD. Environmental Science Information Center. For primary bibliographic entry see Field 2C. W79-05615

APPLICATION OF LANDSAT IMAGERY FOR SNOW MAPPING IN NORWAY,

Norges Vassdrags- og Elektrisitetsvesen, Oslo. H. A. Odegaard, and G. Ostrem.

Available from the National Technical Information

Service, Price code Final Rep ruary 1,

Descripto *Runoff, resource, tains, D Snow, Discharge *Norway

The proje mapping water res cover with observed total volu data are within a data can understo covered graphic c erably ov The area simply by gram sho and subse for sever the same mountain directly y has starte glacierize the transi W79-056

COMPAN WAVE E SOILS V TIONS, Regis Co W. J. Bus Journal o p 287-29

Descripto *Soil mo Radiation processing analysis,

An airbo NASA a soil mois niques ov at midda following tained fro made usi (21 cm) dictions was show waveleng moisture, fects the tensity, curves d (4) incre character sions. Th microwa history o face hist models v condition W79-056

DESIGN CORDIN SOLID-S Kentuck ington. S. A. Dy Available Service, Price coc Research

Data Acquisition—Group 7B

Service, Springfield, VA 22161 as N78-10029, Price codes: A05 in paper copy, A01 in microfiche. Final Report, LANDSAT-2 Contract 29020, February 1, 1977. 62 p, 34 fig, 12 ref. NASA 29020.

Descriptors: *Remote sensing, *Snow cover, *Runoff, *Melt water, Satellites(Artificial), Water resources, Mapping, Watersheds(Basins), Mountains, Data processing, Analytical techniques, Snow, Physical properties, Rivers, Discharge(Water), Snow surveys, Glaciers, *Norway.

The project reported herein dealt with snow cover mapping from satellite imagery to produce data for water resources management. The extent of snow cover within a given high mountain watershed as observed in the spring was related directly to the total volume of melt water run-off. Space-acquired data are valuable if they are received by the user within a few days so that an operational use of the data can be possible. A simple, quick, and easily understood procedure was recommended: snow-covered areas are directly determined on photographic enlargements of LANDSAT images, preferably overlaid on a map of the catchment area. The area extent of snow cover is determined simply by counting squares or grid points. A diagram showing the relation between snow cover and subsequent melt water runoff was established for several given catchment areas, but it seems that the same curve can be used also for other high-mountain drainage basins. The curve can be used directly for runoff forecasts as soon as snowmelt has started. A special method was developed for glacierized watersheds, based upon the height of the transient snowline. (Sims-ISWS) W79-05617

COMPARISON OF 2.8- AND 21-CM MICROWAVE RADIOMETER OBSERVATIONS OVER SOILS WITH EMISSION MODEL CALCULATIONS.
Regis Coll. Research Center, Weston, MA.
W. J. Burke, T. Schmugge, and J. F. Paris.
Journal of Geophysical Research, Vol. 84, No. C1, p 287-294, January 20, 1979. 7 fig, 1 tab, 12 ref.

Descriptors: *Remote sensing, *Model studies, *Soil moisture, Mathematical models, Microwaves, Radiation, Aircraft, Soil water, Temperature, Data processing, Analytical techniques, Correlation analysis, Soils.

An airborne experiment was conducted under NASA auspices to test the feasibility of detecting soil moisture by microwave remote sensing techniques over agricultural fields near Phoenix, AZ, at midday of April 5, 1974 and at dawn of the following day. Extensive ground data were obtained from 96 bare, 16 hectare fields. Observations made using a scanning (2.8 cm) and a nonscanning (21 cm) radiometer were compared with the predictions of a radiative transfer emission model. It was shown that (1) the emitted intensity at both wavelengths correlates best with the near surface moisture, (2) Surface roughness more strongly affects the degree of polarization than the emitted intensity, (3) the slope of the intensity-moisture curves decreases in going from day to dawn, and (4) increased near surface moisture at dawn is characterized by increased polarization of emissions. The results of the experiment indicated that microwave techniques can be used to observe the history of the near surface moisture. The subsurface history must be inferred from soil physics models which use microwave results as boundary conditions. (Sims-ISWS) W79-05633

DESIGN OF A RELIABLE, INEXPENSIVE RECORDING RAIN GAGE WHICH UTILIZES SOLID-STATE MEMORY.
Kentucky Water Resources Research Inst., Lexington.
S. A. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 536, Price codes: A04 in paper copy, A01 in microfiche. Research Report No. 119, 1979. 46 p, 15 fig, 6 tab,

9 ref. OWRT A-072-KY(1). 14-34-0001-7038 (1977), 14-34-0001-8019 (1978).

Descriptors: Instrumentation, *Rain gages, Microprocessors, Remote control.

This report describes a microprocessor-controlled remote recording rain gage which is capable of unattended operation for periods of greater than a month that costs less than \$400.00. The laboratory prototype uses a tipping bucket to collect precipitation in 0.01-inch increments. The time of the bucket tip is stored, using an offset binary format, in solid-state memory. A complete description of the gage hardware is presented along with an outline of the software used. Many improvements to the basic gage design will be possible in the near future as low-power CMOS microprocessors with advanced architectures and high-density magnetic bubble memory become readily available. A reliable and cost-effective gage is suggested to include a tipping bucket, a CMOS time base, a CMOS version of an 8748-like or 6802-like microprocessor, and a 256 kilobit magnetic-bubble memory. W79-05793

APPLICATIONS OF REMOTE SENSING TO WATER RESOURCES.
ECOsystems International, Inc., Gambrills, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as N78-13509, Price codes: A04 in paper copy, A01 in microfiche. NASA Contract Report 150467, December 1977. 50 p, 25 fig, 8 tab. NASA NAS8-32408.

Descriptors: *Remote sensing, *Water resources, *Water demand, Satellites(Artificial), Mapping, Watersheds(Basins), Floods, Wetlands, Precipitation(Atmospheric), Snow cover, Irrigation, Reservoirs, Storage, Water quality, Soil moisture, Water treatment, Cooling water, Water supply, Data management.

In FY-77, the Marshall Space Flight Center (MSFC) Data Management Program activities largely centered around the analyses of selected far-term (1985 and beyond) Office of Applications (OA) objectives, with the intent of determining if significant data-related problems would be encountered and to develop alternative solutions to any potential problems. One far-term OA objective selected for analysis was Water Availability Forecasting. MSFC scheduled a brief overview in FY-77 of the objective—primarily a fact-finding study to allow MSFC Data Management personnel to gain adequate background information to perform subsequent data system analyses. ECOsystems International, Incorporated, provided a significant part of this background material. This report included discussions on some of the larger problems currently encountered in water measurement, the potential users of water availability forecasts, projected demands of users, current sensing accuracies, required parameter monitoring, status of forecasting modeling, and some measurement accuracies likely to be achievable by 1980 and 1990. (Sims-ISWS) W79-05840

AN AUTOMATIC SEQUENTIAL RAIN SAMPLER.
Laboratoire de Chimie Inorganique et Nucleaire, Chemin du Cyclotron, Louvain (Belgium).
C. Ronneau, J. Cara, J. L. Navarre, and P. Priest.
Water, Air, and Soil Pollution, Vol. 9, No. 2, p 171-176, February 1978. 2 fig, 1 tab, 7 ref.

Descriptors: *Rain gages, *Rainfall intensity, *Instrumentation, *Water pollution sources, Measurement, Sampling, Water quality, Air pollution, Automation, Rain water, Foreign research, Precipitation(Atmospheric).

A sequential rain sampler was described. The sampler was designed to operate automatically and unattended in remote areas. Precipitation water is sampled sequentially in order to study the evolution of contaminant concentrations as a function of rain intensities and duration. A few preliminary results were presented; they were related to rain

samples collected in a semi-rural area. Rain is collected by two successive funnels and sampled into polyethylene satchels slipped into polyethylene vials. The sampling sequence is provided by the tilting of successive vials; the tilting occurs when the weight of water sampled is sufficient to balance the counterweights fixed on the vials. As a general rule, there is a net decrease in the concentration of pollutants in water during a precipitation; the reduction factor can be as high as 20 for a 15 minute rain. The rate of diminution generally adopts an exponential form as a function of the quantity of water sequentially sampled. (Humphreys-ISWS) W79-05847

PERSISTENCE AND OROGRAPHIC MODULATION OF MESOSCALE PRECIPITATION AREAS IN A POTENTIALLY UNSTABLE WARM SECTOR.
Royal Signals and Radar Establishment, Malvern (England). Radar Research Lab.
For primary bibliographic entry see Field 2B. W79-05855

PROCEEDINGS FOR GATHERING GROUND TRUTH INFORMATION FOR A SUPERVISED APPROACH TO A COMPUTER-IMPLEMENTED LAND COVER CLASSIFICATION OF LANDSAT-ACQUIRED MULTISPECTRAL SCANNER DATA.
National Aeronautics and Space Administration, Houston, TX. Lyndon B. Johnson Space Center.
A. T. Joyce.
NASA Reference Publication 1015, January 1978. 48 p, 4 fig, 6 ref, 6 appendix.

Descriptors: *Remote sensing, *Classification, *Mississippi, *Computers, Photography, Aerial photography, Maps, Forests, Vegetation, Training, Personnel, Sites, Programming languages, Land use, Land cover, Ground truth data, LANDSAT.

Procedures for gathering ground truth information for a supervised approach to a computer-implemented land cover classification of Landsat-acquired multispectral scanner data were provided in a step-by-step manner. Criteria for determining size, number, uniformity, and predominant land cover of training sample sites were established. Suggestions were made for the organization and orientation of field team personnel, the procedures used in the field, and the format of the forms to be used. Estimates were made of the probable expenditures in time and costs. Examples of ground truth forms and definitions and criteria of major land cover categories were provided in appendixes. (Froehlich-ISWS) W79-05859

QUANTITATIVE ANALYSIS OF AIRCRAFT MULTISPECTRAL-SCANNER DATA AND MAPPING OF WATER-QUALITY PARAMETERS IN THE JAMES RIVER IN VIRGINIA.
National Aeronautics and Space Administration, Langley Station, VA. Langley Research Center.
R. W. Johnson, and G. S. Bahn.
NASA Technical Paper 1021, December 1977. 31 p, 11 fig, 6 tab, 11 ref.

Descriptors: *Virginia, *Remote sensing, *Water quality, Mapping, Rivers, Analysis, Sediments, Statistical methods, Photography, Aerial photography, Suspended solids, Nutrients, Water pollution, Equations, Chlorophyll, Measurement, Nitrites, Data collections, *James River(VA).

Statistical analysis techniques were applied to develop quantitative relationships between in situ river measurements and the remotely sensed data that were obtained over the James River in Virginia on May 28, 1974. The remotely sensed data were collected with a multispectral scanner and with photographs taken from an aircraft platform. Concentration differences among water-quality parameters such as suspended sediment, chlorophyll a, and nutrients indicated significant spectral variations. Calibrated equations from the multiple regression analysis were used to develop maps that

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indicated the quantitative distributions of water-quality parameters and the dispersion characteristics of a pollutant plume entering the turbid river system. Results from further analyses that use only three preselected multispectral-scanner bands of data indicated that regression coefficients and standard error of estimate were not appreciably degraded compared with results from the 10-band analysis. (Froehlich-ISWS)

W79-05862

REGIONAL MEAN BOWEN RATIOS DEDUCED FROM DIURNAL CHANGES OF TEMPERATURE AND HUMIDITY,
Edinburgh Univ. (Scotland). Dept. of Meteorology.

For primary bibliographic entry see Field 2A.
W79-05883

FLIGHT PATH CURVATURE DISTORTION IN SIDE-LOOKING AIRBORNE RADAR IMAGERY,

Geological Survey, Tacoma, WA. Water Resources Div.

C. H. Ling, L. A. Rasmussen, and W. J. Campbell. Photogrammetric Engineering and Remote Sensing, Vol. 44, No. 10, p 1255-1260, October 1978. 2 fig, 2 tab, 2 ref.

Descriptors: *Remote sensing, *Mapping, *Aerial photography, *Analytical techniques, Navigation, Radar, Aircraft, *Terrain analysis.

Although several of the errors in obtaining SLAR (Side-Looking Airborne Radar) imagery can be substantially corrected electronically, the error due to the curvature of the flight path cannot be. For a 130 km flight over the Alaskan coast this error is estimated to be as much as 2.8 km. A correction method is proposed that requires only a few points identifiable both on the image and on the map. It employs a quasi-circular piecewise function passing through these identifiable points, which enables the image coordinates of any other points to be rapidly converted to map coordinates. Synthetic test data and the Alaskan imagery indicate that the error remaining after applying this curvature correction is about 0.2 km. (Woodard-USGS)

W79-05973

CONCENTRATIONS OF METALS IN VERY SMALL VOLUMES OF SOIL SOLUTION,
Geological Survey, Denver, CO. Geological Div. T. Hinkley.

Nature, Vol. 277, p 444-446, 8 February 1979. 1 fig, 4 tab, 17 ref.

Descriptors: *Soil analysis, *Soil water, *Chemical analysis, *Metals, *Analytical techniques, Mass spectrometry, Stable isotopes, Soil-water-plant relationships, Chemical properties, *Soil solutions.

A new method of sampling very small amounts of soil solution (0.3 g) shows that soil solutions contain high concentrations and unusual proportion of metals. In the soils studied, the solution is close in both metal proportions and total metal mass to what may be taken up annually by the growth of plants at the sites sampled. Composition of soil solution varies seasonally and with depth in soil. (Woodard-USGS)

W79-05976

REMOTE-SENSING AND SUBSURFACE DEFINITION OF FACIES AND STRUCTURE RELATED TO URANIUM DEPOSITS, POWDER RIVER BASIN, WYOMING,

Geological Survey, Denver, CO. Geologic Div. G. L. Raines, T. W. Offield, and E. S. Santos. Economic Geology, Vol. 73, p 1706-1723, 1978. 13 fig, 17 ref.

Descriptors: *Remote sensing, *Satellites(Artificial), *Infrared radiation, *Uranium radioisotopes, *Mineralogy, Subsurface investigations, Wyoming, Fluvial sediments, Groundwater movement, Geochemistry, Water chemistry,

*Uranium deposition, *Landsat images, *Southern Powder River basin(Wyo).

Computer-enhanced Landsat images of the southern Powder River basin have been used to define facies and linear structural features within the Wasatch Formation. The facies distribution is detectable primarily because of a relation of vegetation density and type to the local substrate. The surface indications of facies are confirmed by sandstone/mudstone ratios determined from logs of abundant exploration drill holes. These newly defined geologic features are spatially related to known uranium mineral occurrences and are believed to be related to mineralization in the following ways. (1) Major uranium occurrences are virtually restricted to an intermediate grain-size facies of the Wasatch, probably marking the axial zone of the depositional basin. (2) The axial zone is also marked by a change from one structural lineament domain to another, and the structures may have influenced details of fluvial-system patterns and sedimentation and (subsequently) the flow of uranium-bearing ground water. (3) A recently active linear structure may mark the current basin axis; it appears to have some relationship both to ground-water chemistry and the distribution of uranium occurrences, suggesting structural influence on relatively modern ground-water transport and uranium deposition. (Woodard-USGS)

W79-05977

7C. Evaluation, Processing and Publication

PROCEEDINGS OF THE FIRST MEMBERSHIP CONFERENCE OF THE NATIONAL WATER DATA EXCHANGE, MAY 9-11, 1978, DENVER, COLORADO,

Geological Survey, Reston, VA. Water Resources Div.

B. M. Myers, and J. M. Nokes.

Geological Survey open-file report 79-206, 1979. 217 p, 3 append.

Descriptors: *Information exchange, *Hydrologic data, *Conferences, *Data processing, *Computer programs, Data storage and retrieval, Indexing, *National Water Data Exchange(NAWDEX).

This report contains the proceedings of the first membership conference of the National Water Data Exchange (NAWDEX). The purpose of the conference was to acquaint participants in the NAWDEX program with the systems, data resources, and services available throughout the membership, to establish improved personal relationships within the membership, and to serve as a forum for the exchange of ideas and expertise on matters relating to improving the operation of NAWDEX and identifying the needs of the water-data community. Sixteen papers were presented at the conference which describe data systems of member organizations, needs of the data community, and programs of national interest. These papers are published in their entirety in this proceedings volume. Four working panels were also conducted dealing with (1) Program Administration, Management, and Coordination; (2) Recommended Standards for the Handling and Exchange of Water Data; (3) Water Data Indexing and Technical Systems Development; and (4) Request, Response and Service Activities. The reports and conclusions of these panels are included also. (Woodard-USGS)

W79-05583

HYDROLOGIC DATA FOR WATER-TABLE AQUIFERS IN THE BOULDER-FORT COLLINS-GREELEY AREA, FRONT RANGE URBAN CORRIDOR, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.

P. A. Schneider, Jr., and D. E. Hillier.

Availability: OFSS, USGS Box 25425, Dep. Fed. Ctr. Denver, CO., 80225, Paper copy \$12.00, microfiche \$4.00. Geological Survey open-file report 78-567, July 1978. 35 p, 2 fig, 1 plate, 2 tab, 6 ref.

Descriptors: *Hydrologic data, *Water table aquifers, *Well data, *Water levels, *Water quality, Data collections, Water wells, Chemical analysis, Sites, Maps, Colorado, *Boulder-Fort Collins-Greeley area.

As part of the U.S. Geological Survey's investigations of the hydrology and geology in the Front Range Urban Corridor of Colorado, hydrologic data relating to water-table aquifers were compiled during 1976-77. These data consisting of records of 446 wells and chemical analyses of water from 208 wells in the Boulder-Fort Collins-Greeley area, are presented in tabular form. The well-data tables contain records that were collected during 1976-77. The chemical analysis tables contain records that were collected during 1956-77. State and local officials in the Boulder-Fort Collins-Greeley area may find these data useful in planning for residential, commercial, and industrial development. (Woodard-USGS)

W79-05594

THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER IN MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.

G. J. Dalsin.

Geological Survey Water-Resources Investigations 78-106 (open-file report), 1978. 2 sheets, 13 fig, 3 tab, 21 ref.

Descriptors: *Groundwater resources, *Aquifer characteristics, *Water yield, *Hydrogeology, *Water quality, Water wells, Maps, Hydrologic data, Water utilization, Irrigation, Industrial water, Water supply, Water demand, Groundwater availability, Mississippi, *Mississippi River valley alluvial aquifer.

The Mississippi River valley alluvial aquifer, of Quaternary age, contains freshwater in an area of 7,000 sq mi adjacent to the Mississippi River in northwestern Mississippi, and in a 500 sq mi irregular area in southwestern Mississippi. It is the highest yielding aquifer in Mississippi with individual well yields as high as 5,000 gal/min. Major wells producing from the aquifer range in depth from 60 to 260 ft and are commonly screened in the coarse gravel at the base of the aquifer. Water levels in wells are generally between 5 and 30 feet below land surface, except near points of heavy pumping. Water from the alluvial aquifer is a hard, calcium bicarbonate type containing excessive iron in most places. In 1975, 745 Mgal/d, mostly for irrigation, were withdrawn from the alluvial aquifer. In the 7,000 sq mi area in northwestern Mississippi, the alluvial aquifer has been estimated to be capable of yielding over 1,700 Mgal/d, not including the 500 sq mi area in southwestern Mississippi. (Woodard-USGS)

W79-05597

WATER RESOURCES DATA FOR WYOMING, WATER YEAR 1977—VOLUME 1. MISSOURI RIVER BASIN,

Geological Survey Cheyenne, WY. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 493, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WY-77-1, October 1978. 616 p, 9 fig.

Descriptors: *Wyoming, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Missouri River basin.

Water resources data for the 1977 water year for Wyoming consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. This report, in two volumes, contains discharge records for 214 gaging stations; stage only records for 1 lake; stage and contents for 16 lakes and reservoirs; water

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quality for 117 gaging stations, 41 ungaged stations, 2 reservoirs, and 247 wells and springs; and water levels for 45 observation wells. Also included are 101 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Wyoming. (Woodard-USGS) W79-05598

WATER RESOURCES DATA FOR WYOMING, WATER YEAR 1977—VOLUME 2, GREEN RIVER BASIN, BEAR RIVER BASIN, SNAKE RIVER BASIN,
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-293 494, Price codes: A21 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WY-77-2, December 1978. 484 p, 6 fig.

Descriptors: *Wyoming, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, *Gaging stations, *Streamflow, *Flow rates, *Sediment transport, *Water analysis, *Water temperature, *Chemical analysis, *Lakes, *Reservoirs, *Water wells, *Water levels, *Data collections, *Sites, *Green River basin, *Bear River Basin, *Snake River basin.

Water resources data for the 1977 water year for Wyoming consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. This report, in two volumes, contains discharge records for 214 gaging stations; stage only records for 1 lake; stage and contents for 16 lakes and reservoirs, and 247 wells and springs; and water levels for 45 observation wells. Also included are 101 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Wyoming. (Woodard-USGS) W79-05599

MAP SHOWING DRAINAGE AREAS, COLUMBIA QUADRANGLE, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
M. P. Thomas.
Availability: Branch of Distribution, USGS 1200 S. Eads St., Arlington, VA. 22202 price \$0.75. Geological Survey Miscellaneous Field Studies Map MF-941-A, 1978. 1 sheet.

Descriptors: *Maps, *Drainage area, *Connecticut, *Streamflow, *Sampling, *Sites, *Gaging stations, *Water quality, *Topography, *Columbia quadrangle.

A map, scale 1:24,000, shows drainage areas for the Columbia quadrangle, Connecticut. Also included are generalized directions of streamflow and sites for stream gages, surface-water sampling, outlets of surface-water impoundments, and mouths of tributary streams. (Woodard-USGS) W79-05600

MAP SHOWING DRAINAGE AREAS, NORFOLK QUADRANGLE, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
M. P. Thomas, and R. L. White.
Availability: Branch of Distribution, USGS 1200 S. Eads St., Arlington, VA. 22202 price \$0.75. Geological Survey Miscellaneous Field Studies Map MF-942-A, 1978. 1 sheet.

Descriptors: *Maps, *Drainage area, *Connecticut, *Streamflow, *Sampling, *Sites, *Gaging stations, *Water quality, *Topography, *Norfolk quadrangle.

A map, scale 1:24,000, shows drainage areas for the Norfolk quadrangle, Connecticut. Also included are generalized directions of streamflow and sites for stream gages, surface-water sampling, outlets of surface-water impoundments, and mouths of tributary streams. (Woodard-USGS) W79-05601

MAP SHOWING DRAINAGE AREAS, NEW BRITAIN QUADRANGLE, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
M. P. Thomas, and R. L. Melvin.
Availability: Branch of Distribution, USGS, 1200 S. Eads St., Arlington, VA. 22202 Price \$0.75. Geological Survey Miscellaneous Field Studies Map MF-523-D, 1978. 1 sheet.

Descriptors: *Maps, *Drainage area, *Connecticut, *Streamflow, *Sampling, *Sites, *Gaging stations, *Water quality, *Topography, *New Britain quadrangle.

A map, scale 1:24,000 shows drainage areas for the New Britain quadrangle, Connecticut. Also included are generalized directions of streamflow and sites for stream gages, surface-water sampling, outlets of surface-water impoundments, and mouths of tributary streams. (Woodard-USGS) W79-05602

MAP SHOWING DRAINAGE AREAS, COLLINSVILLE QUADRANGLE, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
M. P. Thomas, and P. A. Adams.
Availability: Branch of Distribution, USGS, 1200 S. Eads St., Arlington, VA. 22202 Price \$0.75. Geological Survey Miscellaneous Field Studies Map MF-534-B, 1978. 1 sheet.

Descriptors: *Maps, *Drainage area, *Connecticut, *Streamflow, *Sampling, *Sites, *Gaging stations, *Water quality, *Topography, *Collinsville quadrangle.

A map, scale 1:24,000, shows drainage areas for the Collinsville quadrangle, Connecticut. Also included are generalized directions of streamflow and sites for stream gages, surface-water sampling, outlets of surface-water impoundments, and mouths of tributary streams. (Woodard-USGS) W79-05603

RECORD OF WELLS IN THE FLORIDIAN AQUIFER IN DADE AND MONROE COUNTIES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
T. R. Beaven, and F. W. Meyer.
Geological Survey open-file report 78-881, October 1978. 30 p, 5 fig, 9 tab, 9 ref.

Descriptors: *Well data, *Aquifers, *Water levels, *Water quality, *Potentiometric level, *Water analysis, *Chemical analysis, *Inorganic compounds, *Dissolved solids, *Hardness (Water), *Trace elements, *Hydrogen sulfide, *Florida, *Dade County (FL), *Monroe County, *Floridian aquifer.

The utilization of the Floridian aquifer as a source of potable water has increased. The use of the Floridian aquifer for subsurface storage of freshwater, and as an industrial water supply in Dade and Monroe Counties, is being considered by water management authorities and some industries. Information on locations, depths, casings, and year drilled for 67 wells that penetrate the Floridian aquifer in Dade and Monroe Counties is presented to assist in planning future uses of the Floridian. Chloride concentrations in water from wells ending in the Floridian aquifer in Dade County ranged from 1,200 to 9,000 milligrams per liter. In Monroe County the chloride concentrations ranged from 1,600 to 20,000 milligrams per liter. Water levels were measured in selected wells to determine the altitude of the potentiometric surface. The measurements indicate that the 40-foot potentiometric line extends from southern Dade

County to the upper Florida Keys. (Woodard-USGS) W79-05606

WATER RESOURCES OF SOUTH-CENTRAL IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
J. W. Cagle, and A. J. Heinritz.
Iowa Geological Survey Water Atlas No. 5, 1978. 97 p, 39 fig, 14 tab, 36 ref.

Descriptors: *Available water, *Surface waters, *Groundwater resources, *Water quality, *Iowa, *Water supply, *Water utilization, *Municipal water, *Industrial water, *Domestic water, *Potable water, *Streamflow, *Regulated flow, *Water storage, *Reservoirs, *Lakes, *Hydrologic data, *Maps, *South-central Iowa.

Information is presented on the availability, quality, and use of ground and surface water in an eleven-county area in south-central Iowa. The best sources of water supply in the area are Red Rock and Rathbun Lakes and other impoundments. The Des Moines River is the only stream in the area that can supply adequate amounts of water without storage. Yields of as much as 1,000 gallons per minute (gal/min) are available to individual wells from the deeply-buried Cambrian-Ordovician aquifer. Yields of 150 to 500 gal/min can be obtained from the alluvial aquifer in the valleys of the Des Moines and Skunk Rivers; yields from the alluvium in tributary valleys range from 25 to 100 gal/min. The Pennsylvanian, Mississippian, and Devonian aquifers, although capable of furnishing 100 gal/min or more locally, generally yield only 3 to 25 gal/min. The deep drift and buried-channel aquifers will yield as much as 25 gal/min at places and occasionally as much as 60 gal/min. The chemical quality of surface water is suitable for most purposes; dissolved solids generally are less than 500 milligrams per liter (mg/L). Water with less than 500 mg/L dissolved solids is available from parts of all aquifers except the Devonian but only the alluvial and shallow drift aquifers contain water with less than 500 mg/L in most parts of the aquifer. Water withdrawals averaged about 26 million gallons per day in 1972-73; ground water accounted for 66 percent of the total withdrawals and surface water sources made up 34 percent. (Woodard-USGS) W79-05609

THE USE OF SNOWCOVERED AREA IN RUNOFF FORECASTS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2C. W79-05611

THE TRANSMISSIVITY ITERATIVE CALCULATION ROUTINE—THEORY AND NUMERICAL IMPLEMENTATION,
Battelle Pacific Northwest Labs., Richland, WA. Water and Land Resources Dept.
D. B. Cearlock, K. L. Kipp, and D. R. Friedrichs.
Available from the National Technical Information Service, Springfield, VA 22161 as BNWL-1706, Price codes: A06 in paper copy, A01 in microfiche. Report BNWL-1706, December 1972, Revised May 1975. 111 p, 55 fig, 11 tab, 20 ref, 2 append. AT(45-1)-2130.

Descriptors: *Transmissivity, *Theoretical analysis, *Aquifers, *Numerical analysis, *Computer models, *Mathematical models, *Hydraulic conductivity, *Heterogeneity, *Computer programs, *Flow, *Dupuit-Forchheimer theory, *Distribution, *Data processing, *Data collections, *Aquifer characteristics, *Model studies, *Equations, *Boussinesq equation, *Flowlines, *Sensitivity, *Digitizer.

A computer routine, the Transmissivity Iterative Routine (TIR), has been developed for calculating the hydraulic conductivity distribution in highly heterogeneous aquifers where characterization by field measurement methods alone would be prohibitive in cost. The method is based on the numerical

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integration of the Boussinesq equation for the hydraulic conductivity along instantaneous stream-tubes of flow. The routine yields the two-dimensional distribution of hydraulic conductivity averaged over the aquifer thickness. The program was written for an interactive computer system with a light-pen, CRT display, and graphical digitizer, which allow rapid reinterpretation and evaluation of groundwater contours. The TIR was implemented on the Hanford unconfined aquifer, and an approximation to the vertically averaged hydraulic conductivity distribution was calculated. Preliminary verification of this distribution, accomplished by simulating the groundwater potential changes as functions of time for the period 1968 through 1973, was surprisingly good, considering the estimated accuracy of the input data, for those regions where enough data were available. The tests and verification calculations performed demonstrated the usefulness of the TIR method for: (1) generating hydraulic conductivity distributions for heterogeneous aquifers; (2) systematically evaluating the adequacy and reliability of existing data; and (3) specifying the type, quantity and location of additional data that would be required to provide the desired accuracy and resolution of aquifer conductivity. (Visocky-ISWS)
W79-05614

ANALYSIS AND DISSEMINATION OF WATER RESOURCES INFORMATION

South Dakota State Univ., Brookings. Water Resources Research Inst.
M. L. Horton, J. L. Wiersma, and C. G. Carlson. Available from the National Technical Information Service, Springfield, VA 22161 as PB-294 540. Price codes: A03 in paper copy, A01 in microfiche. Completion Report, February 1979. 43 p, 10 fig, 4 ref, append. OWRT A-050-SDAK(1). 14-31-0001-5042.

Descriptors: Data processing. Computer programs. Spatial distribution.

A computer assisted program was developed to process, summarize and map water resources data. The data banks used in the study were analyses of water for water quality performed in the Water Quality Laboratory, water resources survey data from state-wide and county sources, and water rights locations. Spatial maps illustrating the distribution and water quality and quantity parameters and data summaries were prepared for user agencies. The program is not confined to water resource data. Most field and laboratory data have been collected and geographically located according to legal description (township and range). The developed program involves the transformation of geographical location of data sites by legal description into a latitude-longitude system. Once the transformation is completed, large volumes of data can be mapped or displayed using the computer assisted method. (Wiersma-South Dakota)
W79-05792

PROBABLE MAXIMUM PRECIPITATION ESTIMATES, UNITED STATES EAST OF THE 105TH MERIDIAN

National Weather Service, Silver Spring, MD. Office of Hydrology.

For primary bibliographic entry see Field 2B.

W79-05863

AVAILABILITY OF GROUND WATER IN THE LOWER MERRIMACK RIVER BASIN, SOUTHERN NEW HAMPSHIRE

Geological Survey, Concord, NH. Water Resources Div.
J. E. Cotton.

Geological Survey Water-Resources Investigations

77-69 (open-file report), 1977. 1 sheet, 14 ref.

Descriptors: *Groundwater resources, *Aquifers, *Groundwater availability, *Water quality, *New Hampshire, Maps, Water wells, Well data, Water yield, *Merrimack River basin(NH).

This map, scale 1:125,000, is a preliminary assessment of the availability of ground water in the

lower Merrimack River basin in southern New Hampshire. It is a generalization of several hydro-geologic factors and provides a guideline for ground-water exploration, which is useful in water- and land-use planning. It does not describe the absolute quantity or quality of ground water available. The best aquifers in the basin are deposits of stratified sand or sand and gravel of Pleistocene age. Large aquifers of this type occur in places in the Merrimack River valley and in valleys of tributaries to the Merrimack River. Ground water is generally of good chemical quality. Iron and manganese in concentrations greater than the recommended limits for drinking water suggested by the U.S. Public Health Service, however, are not uncommon. (Woodard-USGS)
W79-05968

POTENTIOMETRIC SURFACE OF FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT AND ADJACENT AREAS, SEPTEMBER 1978

Geological Survey, Tampa, FL. Water Resources Div.

R. M. Wolansky, L. R. Mills, W. M. Woodham, and C. P. Laughlin.
Geological Survey open-file report 78-1035, 1978. 1 sheet.

Descriptors: *Maps, *Aquifers, *Water levels, *Potentiometric level, *Florida, Water wells, Water utilization, Irrigation, Water level fluctuations, *Floridan aquifer, Southwest Florida Water Management.

A September 1978 potentiometric-surface map depicts the annual high water-level period of the Floridan aquifer in the Southwest Florida Management District. Potentiometric levels increased 10 to 25 feet between May 1978 and September 1978, in the citrus and farming sections of southern Hillsborough, northern Hardee, southwestern Polk and Manatee Counties. These areas are widely affected by pumping for irrigation and have the greatest fluctuations in water-levels between the low and high water-level periods. Water-level rises in coastal, northern and southern areas of the Water Management District ranged from 0 to 10 feet. (Woodard-USGS)
W79-05983

PHYSIOGRAPHY AND SURFICIAL GEOLOGY OF THE COPPER-NICKEL STUDY REGION, NORTHEASTERN MINNESOTA

Geological Survey, St. Paul, MN. Water Resources Div.
P. G. Olcott, and D. I. Siegel.
Geological Survey Water-Resources Investigations

78-51 (open-file report), 1978. 22 p, 2 fig, 3 plates, 4

tab, 22 ref.

Descriptors: *Geomorphology, *Hydrogeology, *Regional analysis, *Geology, *Minnesota, Topography, Bedrock, Particle size, Petrology, Glacial drift, *Copper-Nickel study region(Minn), Physiography.

The Copper-Nickel study region lies in the Superior Upland physiographic province and is located approximately 60 miles north of Duluth and 100 miles southeast of International Falls, Minnesota. It straddles the Laurentian Divide, which separates Hudson Bay and Lake Superior drainage. The topography exhibits a southwestward trending lineation that parallels the strike of southeastward-dipping bedrock units and the southwestward direction of ice movement during Pleistocene glaciation. For this study, the region has been divided into seven physiographic areas based on geomorphic features related to the bedrock surface, glacial deposits, and hydrogeologic significance. The surficial geology is largely a result of two southwestward advances of the Rainy Lobe of the Laurentian ice sheet. The Toimi Drumlin Field, the oldest glacial deposit, covers much of the southern part of the region. It is bounded on the north by the Vermilion Moraine Complex, an east-west trending series of terminal and recessional moraines that mark the southerly extent of the second advance of the Rainy Lobe. Thin ground moraine

and small outwash deposits occur both within and north of the Vermilion Moraine Complex except in the Embarras and Dunka River basins where outwash deposits up to 200 feet in thickness fill a deep bedrock valley. (Woodard-USGS)
W79-05984

WATER RESOURCES DATA FOR KANSAS, WATER YEAR 1978

Geological Survey, Lawrence, KS. Water Resources Div.
Geological Survey Water-Data Report KS-78-1, January 1979. 656 p, 9 fig, 4 tab.

Descriptors: *Kansas, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1978 water year for Kansas consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells. This report contains discharge records for 147 gaging stations, stage and contents for 21 lakes and reservoirs, water quality for 89 gaging stations and 2 lakes, and water levels for about 460 observation wells and water quality for about 460 wells. Also included are data for 100 crest-stage partial-record stations and 23 low-flow partial-record stations. All data in this report represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State and Federal agencies in Kansas. (Woodard-USGS)
W79-05989

8. ENGINEERING WORKS

8A. Structures

EARTH DAMS AND RESERVOIRS,
Soil Conservation Service, Washington, DC. Engineering Div.
For primary bibliographic entry see Field 2H.
W79-05612

REVIEW REPORT ON UMPQUA RIVER AND TRIBUTARIES, OREGON, INTERIM REPORT, SOUTH UMPQUA RIVER, VOLUME III; (APPENDIX B—HYDROLOGY, METEOROLOGY, AND RESERVOIR REGULATION; APPENDIX C—FOUNDATION AND MATERIALS DATA; APPENDIX D—RECREATION, PUBLIC USE, AND ENVIRONMENT),
Army Engineers District, Portland, OR.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A043 962. Price codes: A14 in paper copy, A01 in microfiche. Interim Report, December 1971. 220 p, 83 fig, 17 tab.

Descriptors: *Dams, *Dam foundations, *Hydrology, *Recreation, *Oregon, Damsites, Rivers, Tributaries, Rainfall, Precipitation(Atmospheric), Reservoirs, Reservoir operation, Geology, Rocks, Public access, Environment, Meteorology, Engineering, Civil engineering, +Umpqua River(OR), *South Umpqua River(OR), *Days Creek Dam(OR).

The hydrologic and meteorologic data presented in Appendix B are the bases for establishing channel capacities, reservoir capacity, outlet capacities, spillway design flood, flood control regulation, and water-conservation plans for a comprehensive development of the water resources of South Umpqua River Basin as related to the proposed Days Creek project. That project would be the key storage project in the development of the water resources in the basin. Appendix C showed that foundation conditions and other site considerations are favorable for construction of an embankment-type dam at the proposed site. The site is suitable for use of cut-and-cover construction for the regulating outlet and the diversion conduit.

Hydraulic Machinery—Group 8C

WAVES IN FRONT OF LONG-BASED WEIRS,
Cambridge Univ. (England). Engineering Lab.
A. M. Binnie.

Journal of Hydraulic Research, Vol. 16, No. 4, p 297-307, 1978. 8 fig, 1 tab, 13 ref.

Descriptors: *Weirs, *Channel flow, *Waves(Water), *Model studies, Mathematical models, Theoretical analysis, Channels, Open channel flow, Froude number, Flow, Analytical techniques, Hydraulics, Long-based weirs.

Published details of the flow over long-based weirs indicate the existence of fixed waves on the free surface in front of the weir. Bonham's extensive results were analyzed, and it appears that measurable waves occurred when the Froude number, F , of the approaching stream exceeded 0.4. This is exactly the limit at which waves are seen in an open channel supplied through a contraction, which forms the waves by reducing the momentum of the stream without altering the energy. Thus, the waves seen at the weir were caused, not by the weir, but by the arrangements for producing the stream. This conclusion was supported by experiments in a channel so long that the waves formed by the entry contraction died away before the stream reached the weir. It was shown that, as waves unavoidably formed in a short channel do not greatly disturb the pressure near the bottom, the indications of a float in a well used to measure the weir discharge are not much invalidated if F is kept below 0.6. (Sims-ISWS)
W79-05540

DRAG REDUCTION IN SEWERS: FIRST RESULTS FROM A PERMANENT INSTALLATION,
Bristol Univ. (England). Dept. of Civil Engineering.
R. H. J. Sellin.

Journal of Hydraulic Research, Vol. 16, No. 4, p 357-371, 1978. 8 fig, 1 tab, 11 ref.

Descriptors: *Sewers, *Drag, *Polymers, Flow, Flow rates, Fluid friction, On-site investigations, Equipment, Instrumentation, Water levels, Velocity, Pipes, Municipal wastes, Sewage, Hydraulics, Drag reduction, Polymer dosing.

Tests were described in which drag-reducing polymer additives were used to increase the flow velocity in a municipal sewer. The selected sewer has a diameter of 300 mm, carries the domestic sewage for a population of 10,000, and floods during heavy rainfall due to rainwater infiltration. A permanent polymer dosing station was designed and constructed on this sewer, and flow and depth measurement instruments were included. Although the system was designed to operate automatically during peak discharges, tests were made under dry weather flow conditions which showed increases in sewer velocities of up to 70% using polymer concentrations ranging up to 60 parts per million of Polyox WSR-301. (Sims-ISWS)
W79-05543

8C. Hydraulic Machinery

CAM-LOCK WATER GATE,
Coastal Culvert and Supply, Inc., Eunice, LA. (Assignee).

R. P. DeRouen, and T. Smith.
U.S. Patent No 4,132,385, 8 p, 12 fig, 8 ref; Official Gazette of the United States Patent Office, Vol 978, No 1, p 155, January 2, 1979.

Descriptors: *Patents, *Flow control, *Water control, Gates, High pressure gates, Flow rates, Water gates.

A cam-lock water gate is designed to control the flow of water under pressure and for the purpose of controlling relatively large quantities of water flow from ponds, lakes canal, etc. A primary body member is provided with an aperture and a short section of pipe stub integral with the main body and opening into the aperture. An adjustable gate plate is mounted on the main body and constrained

Construction of a diversion tunnel in the right abutment also appears feasible. In Appendix D, the recreation resources associated with this project were described. (Sims-ISWS)
W79-05616

THE CARE OF EXPLOSIVES,

For primary bibliographic entry see Field 8H.
W79-05998

CLAMP-ON DRILLING CENTRALIZER PERMITS PRECISE DIRECTION CONTROL,

Emtec, Inc., Houston, TX.
W. Sullivan, and R. Oder.
The Oil and Gas Journal, Vol. 76, No. 48, p 56-60, November 27, 1978. 2 fig.

Descriptors: *Drilling equipment, *Centralizers, Drilling, Oil industry, Wells, Hole deviation.

A new stabilizer is described which provides string centralization at any point on a drilling bottom hole assembly (BHA). It can more effectively control hole direction either straight or deviated. The tool has survived extreme downhole stress without movement and can be removed easily afterwards. For straight hole drilling a packed BHA can be made by clamping on centralizers as low and as often as desired. For directional drilling, centralizers can be placed at the exact location calculated to produce the desired angle change. Frequent small connections can keep the hole on course, minimize drilling time, and prevent excessive deviation correction or doglegs. The operation, design, and placement of drilling centralizers are described. A new non-magnetic drilling centralizer composed of manganese bronze is designed to run on a monel drill collar to allow stabilization at the point where deviation surveys are taken. Case histories of successful use of the drilling centralizer with test rigs and down-hole motors are presented. (Purdin-NWWA)
W79-05999

WELDING STILL WIDELY USED IN DRILLING INDUSTRY,

Universal Oil Products, Inc., Saint Paul, MN. Johnson Div.
Johnson Drillers Journal, Vol. 50, No. 6, p 4-8, November-December 1978. 1 fig, 3 tab.

Descriptors: *Drilling equipment, *Welding, Well casings, Electrodes, Water wells, Joints(Connections).

Welding is an essential skill of well drillers used for joining lengths of casing into a continuous string without couplings. Techniques and tools needed to make a good weld are described in detail. Most drillers use flux-coated electrodes, but the metallic inert gas, or MIG process, is becoming more common. The advantages of MIG welding are increased ease and speed, deeper weld penetration, and automatic wire feeding. (Purdin-NWWA)
W79-06000

8B. Hydraulics

SUPERCRITICAL FLOW IN BENDS OF TRAPEZOIDAL SECTION,

Missouri Univ., Columbia, Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W79-05531

MEAN AIR CONCENTRATION OF SELF-AERATED FLOW,

Bureau of Reclamation, Denver, CO.
H. T. Falvey.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY1, p 91-96, January 1979. 2 fig, 8 ref, 1 append.

Descriptors: *Air entrainment, *Aeration, *Open channel flow, Model studies, Mathematical models, Equations, Air, Mixing, Turbulence, Analytical

techniques, Hydraulics, *Air concentration, Aerated flow.

A designer frequently needs to estimate the quantity of air that is transported by open channel flow. A large number of experiments and field measurements have been conducted, but none has led to a simple correlation that relates the mean air concentration with the flow quantities. The purpose of this technical note was to develop a correlation between the mean air concentration and the most significant flow parameters in the fully aerated zone. Dimensional analysis was used to evaluate the relative importance of the various parameters. An expression was developed to approximate the value of the mean air concentration in fully aerated flow. The expression correlated both field and laboratory observations relatively well. Although the expression was developed for fully aerated flow, it possibly could be used to estimate air concentrations in developing flow. (Sims-ISWS)
W79-05537

FLOW PROFILES IN TRAPEZOIDAL CHANNELS BY POCKET CALCULATORS,

Public Power Corp., Athens(Greece). Computing Center.

A. T. Marinou.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY1, Technical Note, p 96-101, January 1979. 2 fig, 1 tab, 1 ref, 1 append.

Descriptors: *Channel flow, *Open channel flow, *Mathematical models, *Computer programs, Flow, Channels, Profiles, Analytical techniques, Mathematics, Equations, Data processing, Hydraulics, *Pocket calculators, Trapezoidal channels.

Determining backwater-curves in trapezoidal channels constitutes a typical problem in open channel hydraulics. For some extreme cases of bulk calculations, a computer, most commonly a desk top one, is required. Excluding the case of a time-sharing system, a desk top computer has the advantage of displaying the results almost immediately after the machine has been fed with the design parameters of the problem. However, present day costs of desk top computers are still rather high, while on the other hand, the price-performance ratio of programmable pocket calculators decreases more drastically compared to the corresponding ratio for desk top computers. The purpose of this note was to indicate the possibility of an efficient use of programmable pocket calculators in solving moderately difficult problems in hydraulics by taking advantage of their low price-performance ratio. With a pocket calculator of more advanced type than the one employed in this research, a more rigorous model for flow profile calculations could be used, and probably other more complex problems in hydraulics could be tackled as well. (Sims-ISWS)
W79-05538

TWO-DIMENSIONAL BUBBLE PLUMES,

New South Wales Univ., Kensington (Australia). Water Research Lab.

D. L. Wilkinson.
Journal of the Hydraulics Division, American Society of Civil Engineers, Proceedings Paper 14383, Vol. 105, No. HY2, p 139-154, February 1979. 9 fig, 2 tab, 13 ref, 3 append.

Descriptors: *Buoyancy, *Bubbles, *Density, Hydraulics, Weber number, Entrainment, Flow, Gases, Ice, Equations, Mathematical studies, Velocity, *Plumes, Two phase flow, Bubble plumes.

The behavior of large- and small-scale bubble plumes was compared with that of plumes in which the buoyancy is miscible with the surrounding fluid. It was found that the structure of bubble plumes is determined by the value of a Weber number based on the ratio of buoyant and surface tension forces at the source. At low Weber numbers, the structure tends to be self-preserving, and the current generating capability is optimized. (Lee-ISWS)
W79-05539

Field 8—ENGINEERING WORKS

Group 8C—Hydraulic Machinery

between parallel guide channels to permit the gate to be adjusted for completely opening the aperture, partially opening the aperture, or completely closing the aperture. A regular duty embodiment employs a simple handle and rod control for adjusting the gate plate as well as locking the cam-lock mechanism to positively retain the gate plate in the set position once adjusted. Another heavy duty embodiment employs heavier materials and heavier construction of the device and also incorporates a security lock bar that enables the gate plate to be locked to prevent unauthorized adjustment. Another embodiment employs a threaded rod with adjusting nut operated by a wheel type control. A modified cam-lock mechanism is also incorporated for locking the gate plate in adjusted position. Rustproof and corrosion resistant materials are used for construction throughout. Because of the lightweight construction all of the devices may be installed without the use of heavy equipment. (Sinha-OEIS)
W79-05951

8E. Rock Mechanics and Geology

PROBLEMS OF THE PERIGLACIAL ZONE (ZAGADNIENIA STREFY PERYGLACJALNEJ)

For primary bibliographic entry see Field 2C.
W79-05543

REVIEW REPORT ON UMPQUA RIVER AND TRIBUTARIES, OREGON, INTERIM REPORT, SOUTH UMPQUA RIVER, VOLUME III; (APPENDIX B—HYDROLOGY, METEOROLOGY, AND RESERVOIR REGULATION; APPENDIX C—FOUNDATION AND MATERIALS DATA; APPENDIX D—RECREATION, PUBLIC USE, AND ENVIRONMENT)

Army Engineers District, Portland, OR.
For primary bibliographic entry see Field 8A.
W79-05616

8F. Concrete

PROCESS FOR PROTECTING ASBESTOS-CEMENT BEARING SURFACES IN RECIRCULATING COOLING WATER SYSTEMS

Betz Labs., Inc., Trevose, PA. (Assignee).
R. C. Schwarz, and B. G. Chestang.
U.S. Patent No. 4,132,526, 4 p., 11 ref.; Official Gazette of the United States Patent Office, Vol. 978, No. 1, p. 201, January 2, 1979.

Descriptors: *Patents, *Water treatment, *Industrial water, *Cooling water, *Inhibition, *Inhibitors, *Chemical reactions, *Asbestos cement, *Water quality control.

A method of inhibiting the destructive effect of water in contact with an asbestos-cement containing structure due to the leaching of the water soluble components of the cement, e.g., calcium and magnesium is described. Water soluble organo phosphonic acid derivatives, water soluble organic and inorganic phosphates, including esters, water soluble polymers of acrylic acid, and water soluble silicates and mixtures are added to water systems. These materials act to change the interfacial surface of the asbestos-cement structures such that the overall solubility of the components of the cement is reduced. It is believed that there is a reaction with the soluble ions, namely calcium and magnesium of the cement to produce a reaction product which is not soluble in water, in essence protecting the interfacial surface. The materials generally may be added in an amount of 0.1 to 10,000, and preferably from about 1 to 100, parts per million parts of water in the system. The treatment will be most effective if water in the system is maintained or adjusted with either base or acid to a pH of 6 to 10 and maintained at a positive Langelier. (Sinha-OEIS)
W79-05949

8H. Rapid Excavation

THE CARE OF EXPLOSIVES,

R. B. McDannald.
Water Well Journal, Vol. 33, No. 1, p. 34-35, January 1979.

Descriptors: *Explosives, *Hazards, *Safety, Storage, Transportation, Shot firing, Drilling, Water wells, Well development, Water yield.

Explosives are versatile, economical and efficient tools in the water well industry. Safety measures to take when shooting with electric caps include: (1) During electric storms or dust storms, don't uncoil wires or use electric blasting caps; (2) When a storm is within eight miles, inform all persons to stay clear of the blasting area; (3) In the immediate vicinity of radio-frequency transmitters, don't uncoil wires or use electric blasting caps; (4) Keep the firing circuit completely insulated from the ground and other conductors; (5) Keep the electric cap wires disconnected from the power source and short circuited until ready to fire. When transporting explosives to the well site a driller should: (1) obey all federal, state and local laws and regulations, (2) prohibit smoking in the vehicle; (3) load and unload explosives carefully; (4) transport blasting caps, metal, flammable or corrosive substances in a separate vehicle. Precautions to be taken in storing explosives include those listed for transporting explosives plus the following: (1) store only in a magazine which is clean, properly located, substantially built, bullet and fire resistant and security locked, (2) if nitroglycerin from deteriorated explosives has leaked it should be washed away thoroughly with a desensitizing agent. (Purdin-NWNA)
W79-05998

8I. Fisheries Engineering

THE CULTURE OF THE DIATOM CHAETOCEROS GRACILIS AND ITS USE AS A FOOD FOR PNEAID PROTOZOAL LARVAE

Oceanic Inst., Waimanalo, HI.
For primary bibliographic entry see Field 5C.
W79-05738

FOURTH NATIONAL WORKSHOP ON ENTRAINMENT AND IMPINGEMENT

For primary bibliographic entry see Field 5C.
W79-05754

ENGINEERING IMPLICATIONS OF NEW FISH SCREENING CONCEPTS

Stone and Webster Engineering Corp., Boston, MA.
Y. G. Mussalli, E. P. Taft, and P. Hofmann.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, IL., p. 367-376, 1978. 9 fig., 14 ref.

Descriptors: *Engineering structures, *Environmental effects, *Intakes, Intakes structures, Engineering, Fish, Screens, Powerplants, Entrainment, *Impingement.

New concepts in screen design, orientation and operation which offer good potential for biological effectiveness are reported. Fish collection and removal concepts involve modifications of conventional traveling water screens so that impinged fish can be removed with minimal stress and mortality. The fish diversion concept employs design features to remove fish from intakes without requiring that they be physically impinged on mechanical screens. The formation of eddies and areas of flow separation downstream in the vicinity of the pump may affect pump performance. Devices have been developed that are designed to alter or take advantage of fish behavioral patterns so that they will avoid entering the intake flow. The use of devices using this concept need to be carefully evaluated for their effect on intake operation. The choice of design depends on its particular effectiveness for the species of fish and on engineering and cost

considerations. (See also W79-05754) (Chilton-ORNL)
W79-05785

MULTIFARIOUS POWER PLANT WATER INTAKE STRUCTURE: A DESIGN TO REDUCE IMPINGEMENT AND ENTRAINMENT MORTALITY

Polytechnic Inst. of New York, Brooklyn. Div. of Civil and Environmental Engineering.
A. S. Goodman, and B. Chezdar.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, IL., p. 377-384, 1978.

Descriptors: *Engineering structures, *Intakes, *Intakes structures, Entrainment, Engineering, Fish, Mortality, Screens, Powerplants, *Impingement.

The design and operation of the structure described are based on, and relate to, knowledge of the concentration, distribution and behavior of aquatic organisms as well as the physical characteristics of rivers and estuaries. The principal biological design features are: adjustable louvers in front of the intake structure to act as a behavioral barrier to fish; curtain walls in front of the screens to provide three alternative levels of water withdrawal; horizontal traveling screens which move in the directions and speed of the ambient water flow; fish handling facilities located between bays and at either end of the intake. The work described has been primarily a desk study and a research and development program is recommended before construction is considered. (See also W79-05754) (Chilton-ORNL)
W79-05786

PRELIMINARY STUDIES ON THE OPERATING ASPECTS OF SMALL SLOT WIDTH WEDGEWIRE SCREENS WITH CONCEPTUAL DESIGNS FOR POWER STATION USE

United Engineers and Constructors, Inc., Philadelphia, PA.
T. H. Key, and J. C. Miller.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, IL., p. 385-392, 1978. 11 fig.

Descriptors: *Engineering structures, *Intakes, *Intakes structures, Cooling water, Entrainment, Environmental effects, Screens, Powerplants.

A prototype intake facility using removable bulkhead-mounted wedgewire screens was evaluated for long-term operating aspects. Results have indicated that the system will operate satisfactorily, with an acceptable level of operation and maintenance. The major problem with the system has been marine biofouling which requires manual cleaning of the screen on a regular basis. Concurrent material testing indicates that the biofouling can be reduced by the use of copper-bearing material. (See also W79-05754) (Chilton-ORNL)
W79-05787

A PRACTICAL INTAKE SCREEN WHICH SUBSTANTIALLY REDUCES THE ENTRAINMENT AND IMPINGEMENT OF EARLY LIFE STAGES OF FISH

Ichthyological Associates, Inc., Middletown, DE.
B. N. Hanson, W. H. Bason, B. E. Beitz, and K. E. Charles.
In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, IL., p. 393-407, 1978. 6 fig., 6 tab., 3 ref.

Descriptors: *Engineering structures, *Intakes, *Intakes structures, Fish, Environmental effects, Entrainment, Screens, Powerplants, *Impingement.

This study demonstrates that profile wire screens have less impact on the aquatic environment than intakes protected by traveling screens. The ability to reduce entrainment and impingement results from the infinite number of escape routes available; the flow dynamics; the rapid decline in approach

SUBJECT INDEX

SCIENTIFIC AND TECHNICAL INFORMATION—Field 10

Secondary Publication And Distribution—Group 10C

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velocity as a fish leaves the screen; the small slot size; and the ambient washing currents. Impingement of fish larger than 20 mm fork length is virtually eliminated. Biofouling is a major operational problem in brackish and marine waters. (See also W79-05754) (Chilton-ORNL) W79-05788

FISHERIES ISSUES RELATED TO WATER DEVELOPMENT IN THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA, California State Dept. of Fish and Game, Stockton. For primary bibliographic entry see Field 6G. W79-05789

PRESENT ENGINEERING LIMITATIONS TO THE PROTECTION OF FISH AT WATER INTAKES, Burns and Roe, Inc., Paramus, NJ. R. T. Richards. In: Fourth National Workshop on Entrainment and Impingement, December 3, 1977, Chicago, IL., p 415-424, 1978. 9 fig, 11 ref.

Descriptors: *Engineering structures, *Environmental effects, *Entrainment, Fish, Intakes, Screens, *Impingement.

This paper discusses the constraints which engineering practicality imposes on the design of fish protection devices. It is suggested that the most practical fish screening approaches include optimization of the location of the point of water withdrawal to avoid concentrations of aquatic organisms; the use of velocity cap horizontal inflow provisions for offshore withdrawals; the use of conventional vertical straight-through traveling screens with limitations on screen approach velocities; angling of the vertical screen arrays to guide fish to escape sluiceways; flush mounting of screens combined with openings in support walls to provide an unobstructed fish passage escape; modification of conventional vertical screens to include fish removal sprays, fish collection lips and a means of bringing the organisms to a recovery system external to the intake itself. (See also W79-05754) (Chilton-ORNL) W79-05790

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

DOCUMENTATION OF DATA AND LITERATURE RELEVANT TO THE ASSESSMENT OF THERMAL POWER PLANT COOLING SYSTEM EFFECTS ON AQUATIC ENVIRONMENTS, Atomic Industrial Forum, Inc., Washington, DC. For primary bibliographic entry see Field 5C. W79-05784

TECHNOLOGY AND ECONOMICS OF INDUSTRIAL POLLUTION ABATEMENT, Illinois Inst. for Environmental Quality, Chicago. For primary bibliographic entry see Field 5B. W79-05865

10C. Secondary Publication And Distribution

BIBLIOGRAPHY OF PUBLICATIONS ON COMPOUNDS OF GAS HYDRATE TYPE, Pittsburgh, Univ., PA. K. W. Allen. Available from the National Technical Information Service, Springfield, VA 22161 as PB-181 512. Price codes: A02 in paper copy, A01 in microfiche. OSW Research and Development Progress Report No. 73, August 1963. K. Kase, Ed. 13 p.

Descriptors: *Bibliographies, *Publications, *Desalination, Hydrates, Gases, Chlorine.

An alphabetical listing, by authors, of complete references for chlorine hydrate, and the significant recent references for all compounds of the gas hydrate type is presented. (Davison-IPA) W79-05572

ESTUARINE RESEARCH: AN ANNOTATED BIBLIOGRAPHY OF SELECTED LITERATURE, WITH EMPHASIS ON THE HUDSON RIVER ESTUARY, NEW YORK AND NEW JERSEY, Geological Survey, Albany, NY. Water Resources Div. For primary bibliographic entry see Field 2L. W79-05593

Documentation of current work in estuarine research and information on recent estuarine research.

W79-05593

Research on Estuarine Mechanisms.

W79-05593

Estuarine Research: An Annotated Bibliography of Selected Literature, with Emphasis on the Hudson River Estuary, New York and New Jersey.

W79-05593

Estuarine Research: An Annotated Bibliography of Selected Literature, with Emphasis on the Hudson River Estuary, New York and New Jersey.

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Estuarine Research: An Annotated Bibliography of Selected Literature, with Emphasis on the Hudson River Estuary, New York and New Jersey.

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